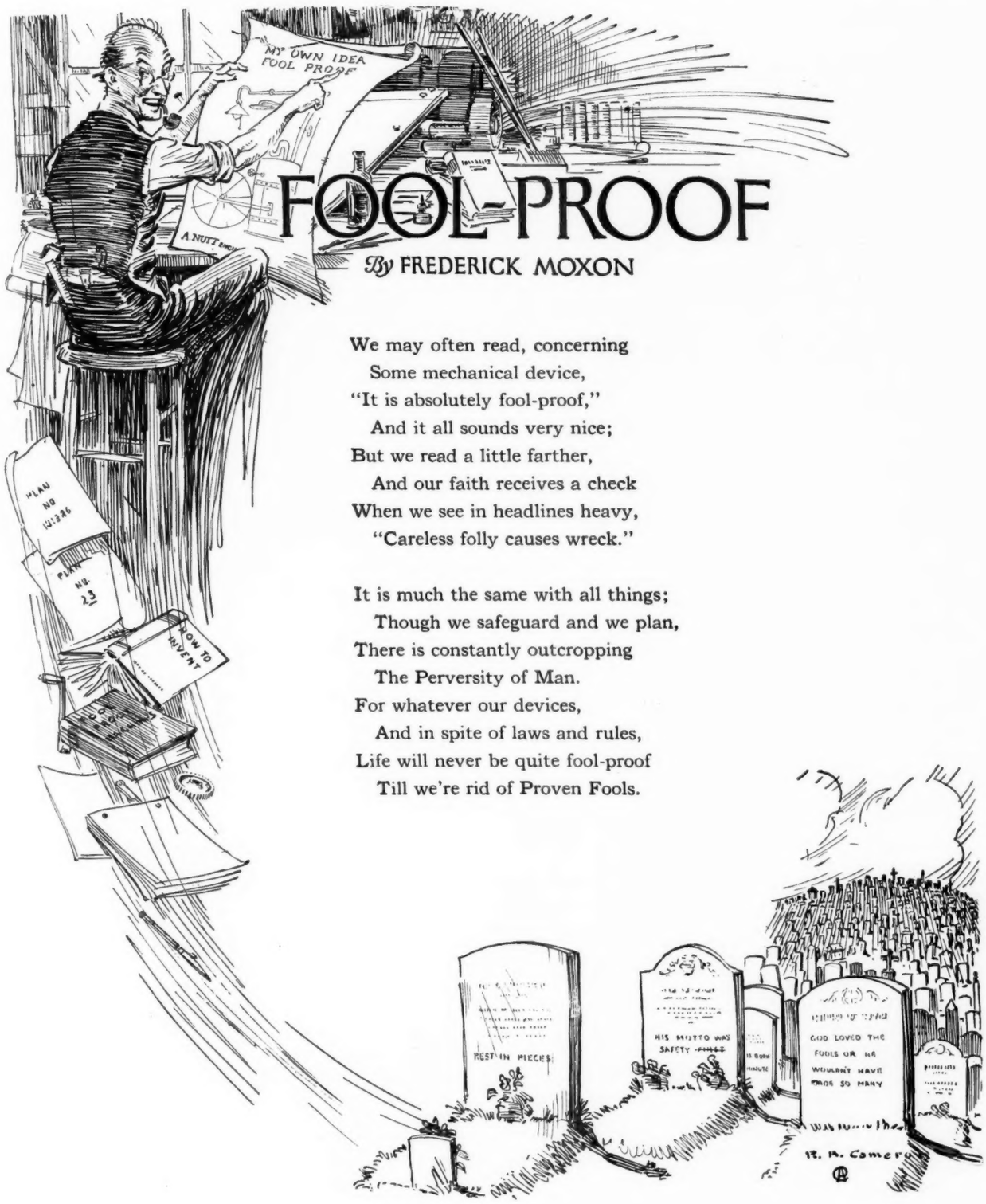
# POWER

*Volume* 49 New York, May 13, 1919 *Number* 19



MY OWN IDEA FOOL PROOF
A NUTT
PLAN NO 10326
PLAN NO 23
HOW TO INVENT
REST IN PIECES
HIS MOTTO WAS SAFETY
GOD LOVED THE FOOLS OR HE WOULDN'T HAVE MADE SO MANY
R. A. Comer

# FOOL-PROOF

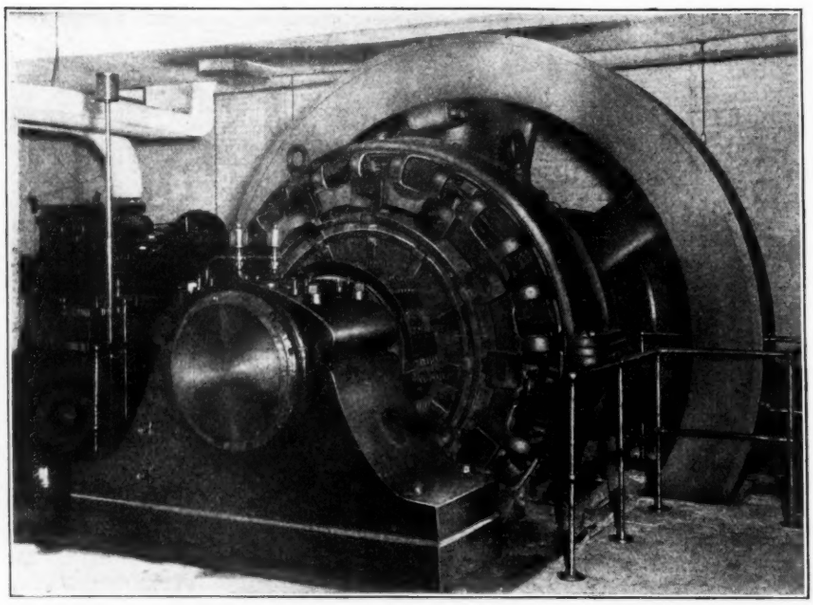
*By* FREDERICK MOXON

We may often read, concerning
Some mechanical device,
"It is absolutely fool-proof,"
And it all sounds very nice;
But we read a little farther,
And our faith receives a check
When we see in headlines heavy,
"Careless folly causes wreck."

It is much the same with all things;
Though we safeguard and we plan,
There is constantly outcropping
The Perversity of Man.
For whatever our devices,
And in spite of laws and rules,
Life will never be quite fool-proof
Till we're rid of Proven Fools.

# Electric and Elevator Equipment of the Hotel Pennsylvania

By Chas. E. Knox,
CONSULTING ELECTRICAL ENGINEER, NEW YORK, N.Y.



THE outstanding requirement of the electrical and elevator equipment of a hotel is service. With the keen competition existing between the hotels today, it is mandatory that the guests be provided with every convenience in the way of lighting, signal systems and elevator service, so that their needs may be quickly satisfied. A brief description of how these requirements are met in the Hotel Pennsylvania, so far as the electrical equipment and elevator service are concerned, may therefore prove of interest.

Three possible sources of current supply were available for the new hotel: First, a private plant in the building; second, the Pennsylvania Railroad power plant; third, the New York Edison Co. In conjunction with the electric-current supply it was of course also necessary to take into consideration the question of the steam supply, and in studying the problem the two were necessarily considered jointly. All three sources of supply mentioned were therefore carefully considered, and a contract was finally made between the hotel operating company and the Pennsylvania Railroad for the supply of both steam and electricity.

It is estimated that approximately 225,000,000 lb. of steam and 5,000,000 kw.-hr. of electricity will be needed each year for the complete building.

There is no question that a private plant for a large hotel is usually more economical in the production of steam and electricity than the purchase of the steam and electricity supply, unless both could be purchased at a lower rate than the present rates filed with the Public Service Commission in the State of New York. In a large hotel, if anywhere, electricity can be produced at a very low rate, due to the great exhaust-steam requirements and also because a hotel is operated twenty-four hours a day 365 days in the year.

After a study of the cost of current production was made, a conclusion was reached that unless the current and steam could be bought at a lower price than the one filed by the Public Service Commission, a saving would be effected by the installation of a private plant. The New York Edison Co. was handicapped by the difficulty of supplying the amount of steam required. A suggestion was made by this company that the boiler plant in the Gimbel Brothers store be enlarged so as to furnish the necessary steam, but this plan involved a number of difficulties and was not looked upon with favor by the owners. Furthermore, the rate suggested was not satisfactory. The choice, therefore, lay between a private plant and the purchase of steam and current supply from the Pennsylvania Railroad.

As the railroad company was the owner of the property, they were naturally anxious to give the hotel operating company as favorable a rate as possible. A thorough technical study was made of the problem by the engineers[1] for the architects and the engineers of the Pennsylvania Railroad. As a result of this study it was finally agreed that both the steam and electricity should be purchased from the Pennsylvania Railroad and that a single engine-driven 500-kw. electric generator (see headpiece) be installed in the building, this unit to be run during the winter months and use live steam, the exhaust being used for heating and for hot-water supply.

The exhaust steam from the steam engine driving the electric generator in conjunction with the exhaust steam from the steam-driven refrigerating plant, air compressors, etc., would thus be available for heating at all times when such amounts of exhaust were required. This steam-driven apparatus would therefore virtually act as a reducing valve with a consequent benefit to the hotel. The load on the generator during the winter months could be adjusted so as to supply exhaust steam in proportion to the heating requirements. On cold days the generator would be run up to its full capacity, and on warm days when the other steam-driven appa-

[1]Messrs. Tenny and Ohmes, on the heating, ventilating and refrigerating equipment and Charles E. Knox on the electrical and elevator equipment, for the architects, McKim, Mead & White.

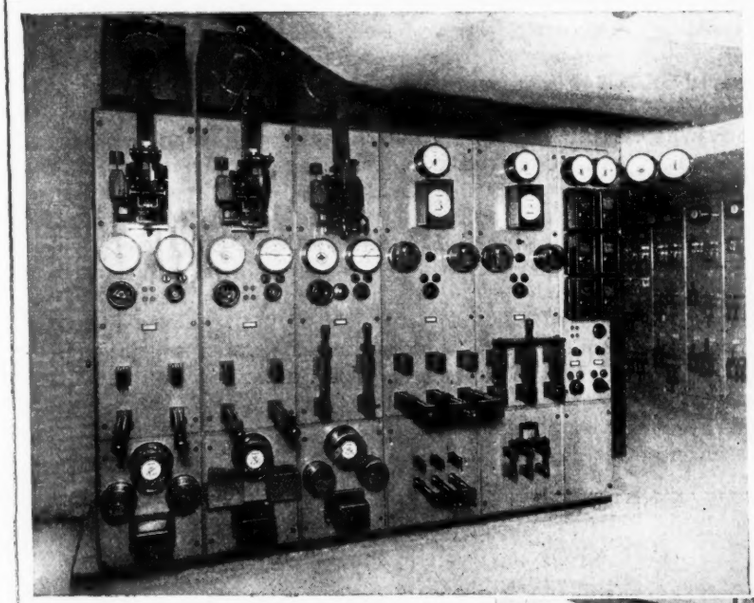
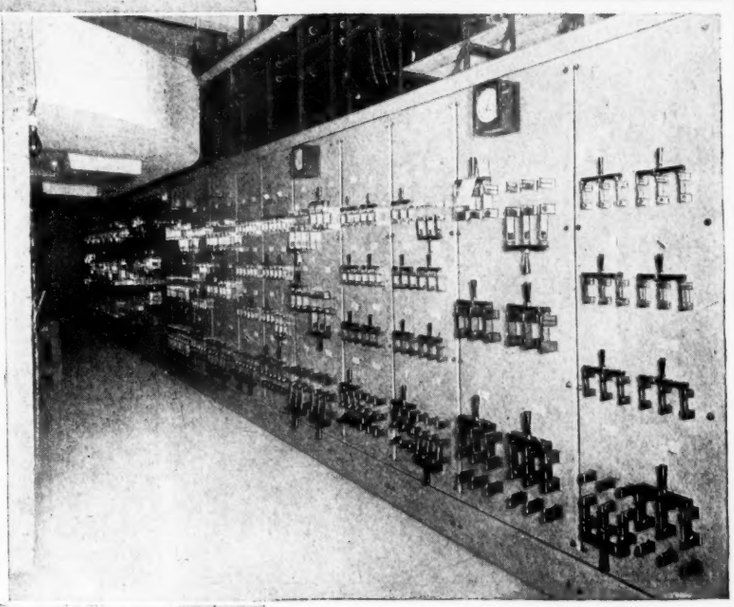


FIG. 1. SIX-PANEL SWITCHBOARD FOR THE CONTROL OF THREE 500-KW. ROTARY CONVERTERS AND THE ALTERNATING-CURRENT POWER AND LIGHTING CIRCUIT

Panels 1, 2 and 3, counting from the left, are for the control of the rotary converters—the field rheostats are shown mounted above the panels. Panels 4 and 5 are for the alternating-current light and power circuits. On panel 6 are mounted two primary ammeters, six reverse-power relays and the control for the service oil switches.

FIG. 2. TWENTY-PANEL SERVICE SWITCHBOARD

Eight panels on the left are for the control of the 240 direct-current power circuit; the next four control the 500-kw. engine-driven direct-current generator, the two 20-kw. balancer sets, and also have mounted on them the bus-tie switches; the remaining eight panels control the three-phase 250-volt power and the 125- to 250-volt single-phase lighting circuits.



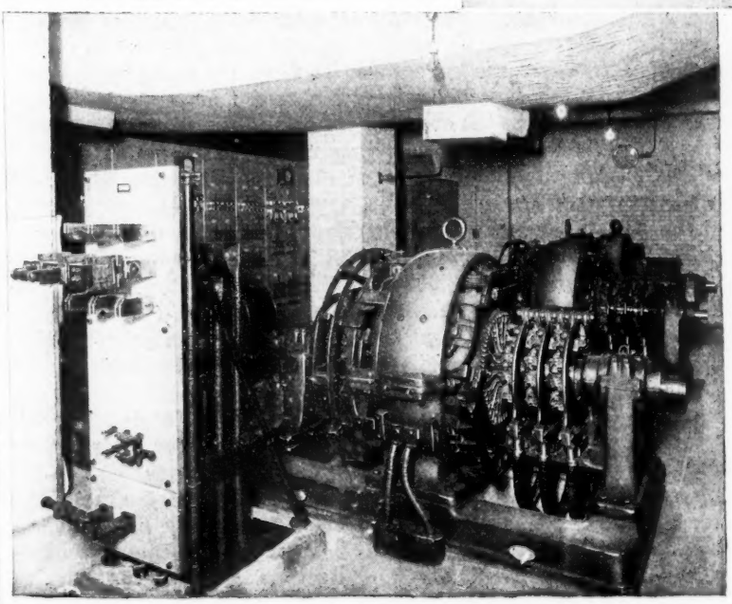


FIG. 3. THREE 500-KW., SIX-PHASE ROTARY CONVERTERS

These machines are compound-wound and are equipped with interpoles. Each converter has its own starting panel, one of which is shown in the foreground. The machines are started from the alternating-current end by connecting them, through a three-pole double-throw switch, to 50 per cent. taps on the transformers.

ratus would furnish a sufficient quantity of exhaust steam, the load on the steam-driven generator would be correspondingly reduced. By this arrangement it is obvious that the cost of current production is reduced to a minimum without the necessity of installing a steam-boiler equipment and complete generating plant. The installation of such a plant would require considerable space that could be well used for other purposes, and its operation would involve the delivery of coal, the removal of ashes and a large operating force.

The electric-current supply, which is 60-cycle three-phase, 11,000-volt alternating current, is obtained from the power plant of the Pennsylvania Railroad, located in Long Island City, being transmitted to the company's service station, on 32nd St. between 7th and 8th Aves., New York City, and from there carried by two sets of No. 000 feeders through a tunnel to a substation, Figs. 4 and 5, adjoining the engine room in the sub-basement of the hotel. These feeders are connected through disconnecting switches and electrically operated oil switches to a ring bus made up of 1-in. copper tubing run exposed. From this bus the power goes to five banks of transformers. Two of these banks, each having three 133⅓-kv.-a. single-phase transformers connected delta to delta, step the 11,000-volt current down to 120 and 240 volts for lighting and miscellaneous power purposes such as the ranges in the kitchen, etc. The ranges use three-phase 240-volt power, and the lighting is supplied at 120 to 240 volts three-wire.

Three other banks of transformers, each consisting of three 233⅓-kv.-a. single-phase units, step the 11,000-volt power down to 187 volts to supply direct current at 240 volts through three six-phase 500-kw. rotary converters, Fig. 3. Three-wire 120- to 240-volt direct current is obtained from two 20-kw. balancer sets operated in conjunction with the rotary converters. The 240-volt direct-current power is used to drive the elevators, ventilating motors, laundry machinery, vacuum cleaners, centrifugal brine pumps, etc.

There are two switchboards in the engine room. One, a six-panel service board, Fig. 1, is equipped with the necessary electrically operated remote control for the oil switches on the high-voltage circuits. On this switchboard are also located the integrating wattmeters for measuring the current supplied to the building, overload relays, reverse-current relays, direct-current circuit-breakers for the rotaries, etc. From this board the power and lighting feeders are run to the hotel distributing board, Fig. 2, consisting of 20 panels, which serves to control the main feeders distributing current to the various parts of the building. In addition to the two switchboards just described, there is one in the laundry for all motor-operated laundry machines, one on the second (service) floor, a six-panel board for all bedroom-floor lights and one on the roof floor to supply power for ventilating motors, elevators and lights on this floor and above.

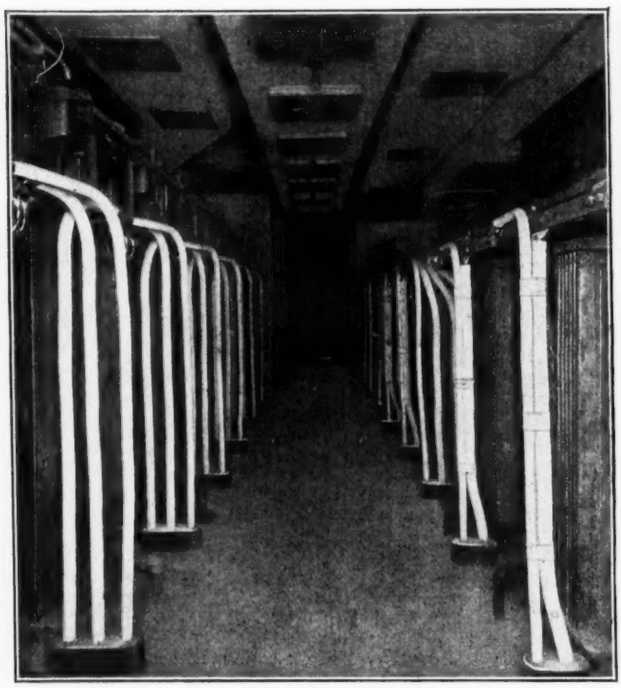


FIG. 4. INTERIOR VIEW OF SUBSTATION

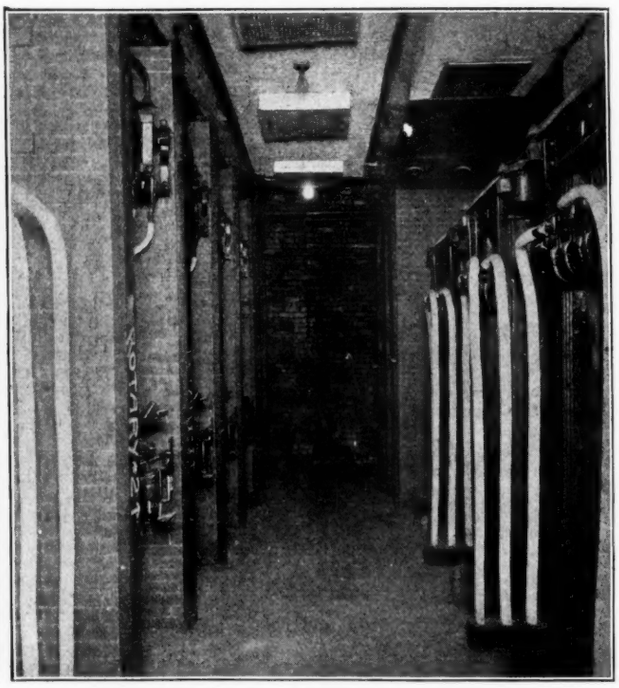


FIG. 5. VIEW OF OIL-SWITCH COMPARTMENTS

There are six subfeeders from the main switchboard to the switchboard on the roof floor and eleven subfeeders to the switchboard on the second (service) floor. There are also 112 power risers having a total of 2456 hp. connected load (not including the laundry). Of these 27 are for elevators, having 1108-hp.; one hundred and eighteen lighting risers feed 240 panel boards supplying an aggregate of 3415 circuits, having a total capacity of 2,253,900 watts. There were used in the installation of the various circuits over 600,000 ft. of conduit of all sizes from ½-in. to 4-in., and about 2,000,000 ft. of wire of all sizes from No. 14 duplex to 2,000,000 circ.mil cable.

As the 27 elevator machines are all located in penthouses on the roof, the current supply for these motors is carried by feeders from the main switchboard in the subbasement to the power switchboard on the roof floor. From this power switchboard the feeders are extended to separate distributing boards, one in the passenger-elevator pent house and a second in the service-elevator penthouse. A tie-line switch is provided on the switch-

board at the roof floor, so arranged that the feeders supplying the passenger and service elevators may be tied together electrically and, by taking advantage of the diversity factory resulting from the operation of the two banks of elevators, gain the benefit of the combined carrying capacity of the two sets of feeders. Additional feeders are run from the main switchboard in the sub-basement to the switchboard on the roof floor for supplying ventilating and other motors located on the roof floor. Lighting feeders run from the main

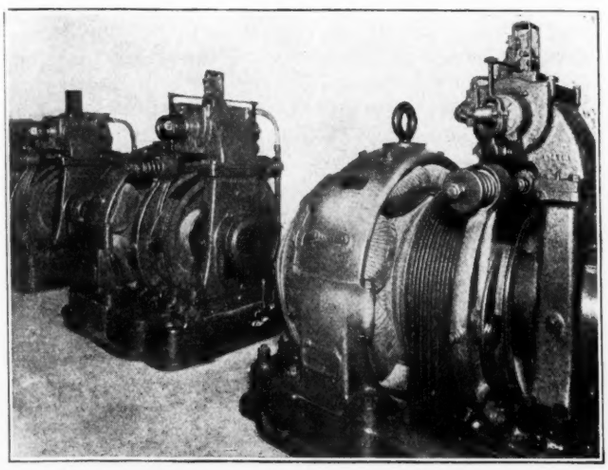


FIG. 6. THREE OF THE TWELVE PASSENGER, DIRECT-TRACTION ELEVATOR MACHINES

switchboard in the sub-basement to the roof switchboard for supplying lighting on the roof floors.

In the design of the feeder system the size and arrangement of the feeders were determined with a view of reducing the amount of copper required to a minimum and at the same time avoiding the possibility of having such variation in voltage as would materially affect the candlepower of the lamps.

The consulting engineer had a large amount of data based on the maximum-demand factor on the feeder systems of various hotels, and the loss was determined on the connected loads using the demand factor found to exist in hotels of this class and the allowable loss then determined. As the variation in candlepower is much more rapid than the variation in voltage, it is obvious that if too great a loss were permitted in the feeders, the resultant reduction in light produced in the lamps might cause complaints from guests and compel an increase in the size of the lamp. On the other hand, good engineering required that no more copper be used than necessary to obtain proper results. Economy was also secured on the branch circuit wiring by putting as many as ten or twelve outlets on a circuit. This is permissible in a hotel for the reason that additional outlets are seldom required in the bedroom portion of hotels, and in this respect it is different from conditions in other types of buildings.

The main feature of interest in the way of illumination is the lighting of the lobby. The ceiling is of glass arranged in an attractive design, supported on steel framework. Special glass in two colors is used, and in the space above the glass ceiling are placed a number of lamps with efficient reflectors, arranged for control in three groups. The lighting effect is very attractive and is obtained with an unusually small expenditure of energy for this type of lighting. Standard fixtures are also located on the floor, which are used in connection with the lighting above the glass ceiling. The service portions of the house are generally lighted by lamps with porcelain enamel steel reflectors, close to the ceiling, the object being to obtain fixtures requiring a minimum amount of cleaning. Metal reflectors are used to accomplish that purpose and also to avoid breakage.

In the design of the signaling systems the object sought was to keep the installation as simple as possible, reducing the initial expenditure to a minimum and at the same time to give the guest every convenience which the exacting demands of a modern hotel require. As an instance of the simplification of design, no push-button calls are provided from the bedrooms, the telephone being used entirely for transmitting the guests' desires and requirements.

On each bedroom floor a floor clerk occupies a desk opposite the main elevators. From this floor clerk's office pneumatic tubes extend to the tube station at the back of the main office, and a telautograph connects with the room clerk, valet, porter, laundry, etc.

The principal means of transmitting information are the telephone, telautograph and pneumatic tubes. The main telephone switchboard consists of 23 positions, including 9 incoming, 2 official and 12 house positions. The incoming positions are used for receiving messages from outside of the hotel; that is, incoming calls. The official positions are used for connections for the administration officers of the hotel and the house positions are used for the guest's service, including the outgoing messages. The telautograph system consists of 60 stations and is used for transmitting messages left by visitors and for breakfast orders, etc., and therefore constitutes an important factor in the hotel.

The watchman's detector system is of the portable type, with the addition that on each floor there is provided a separate watchman's station connecting with an outside supervised service. The fire-alarm system is

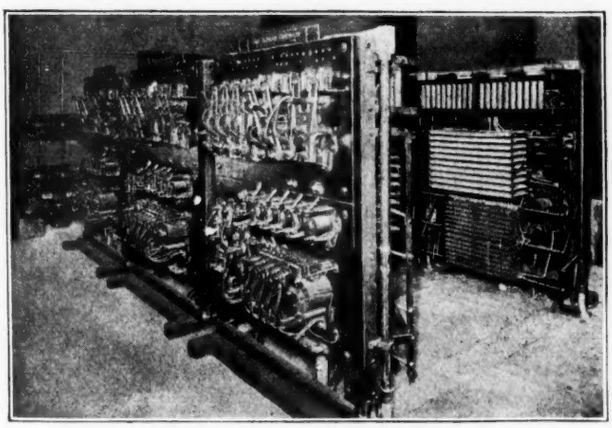


FIG. 7. ELEVATOR-MACHINE CONTROL PANELS

also of the interior type, connecting with the engine room and with an additional signal station on each floor and directly through the National District Telegraph Co. with fire headquarters.

There is one group of main passenger elevators consisting of two rows of six elevators each, opening on the passenger-elevator corridor. These elevators run from the basement to the roof floor, and by placing them in one group it was deemed that better service to the guests would be provided and less confusion would occur in locating the elevators.

Two elevators are installed at the southwest corner of

the building, which serve to carry passengers from the tunnel connecting with the Pennsylvania Railroad station and the subway, to the main floor. At 33rd St. side of the building near the ballroom entrance two elevators are provided for carrying passengers from the main floor to the ballroom floor, about twenty-five feet above the ground floor.

Eight elevators in one bank are provided for the service requirements of the hotel. These elevators extend from the sub-basement to the roof and are arranged to

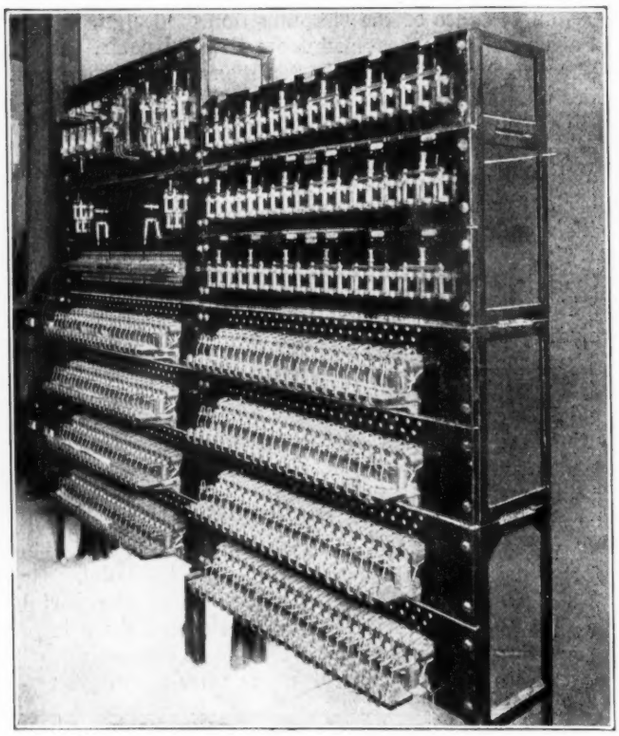


FIG. 8. PASSENGER-ELEVATOR SIGNAL BOARD

be operated in three separate groups so far as signaling is concerned, thereby permitting a certain amount of flexibility in assigning the elevators to different purposes. For example, one pair may be used for waiters exclusively, another pair for baggage, laundry, etc. The passenger elevators are arranged so that one side of (six) elevators may be run local and the other side may be run express. All the passenger and service elevators with the exception of one large service elevator are of the one-to-one gearless-traction type as shown in Fig. 6, running at 600 ft. per min. On the left, Fig. 7, are shown three of the controller panels for the passenger elevators; the arrangement of the resistances and wiring on one controller panel is shown on the right of the figure. The large service elevator, which is approximately nine feet wide by seven feet deep, is of the worm-gear traction type running at 450 ft. per minute.

In the rear of the building there are three additional elevators which serve to carry supplies from the driveway to the lower floors and also to provide service between the sub-basement and the banquet-room kitchen which is located on the first mezzanine floor.

The signal system for the passenger elevators consists of up and down flash-light annunciators in the car with push-buttons and up and down signal lanterns located at the various landings. Fig. 8 shows the signal panel board for the twelve passenger elevators. Dial indicators are placed on the ground floor as well as tell-tale annunciators for furnishing to the elevator starter the necessary information as to the location of cars and the car signals.

Door closers of the pneumatic and spring-actuated type are provided on all passenger and service elevators. On all passenger elevators a simple safety device is used to prevent the car moving until both the hatchway door and the car gate are closed.

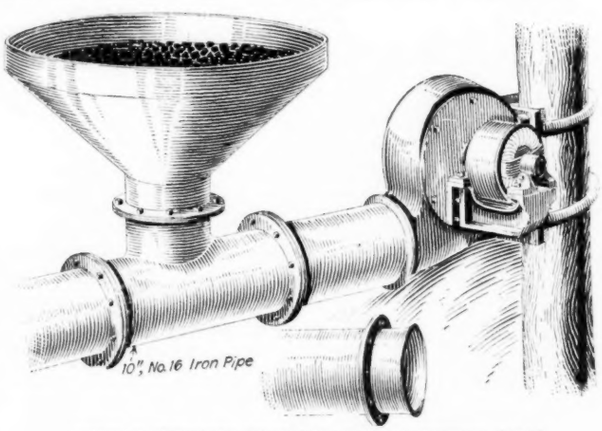
A bank of six dumbwaiters is provided for furnishing service between the kitchen and the various floor pantries, one being located on each of the bedroom floors. These dumbwaiters are operated on the single-point control plan; that is, an operator in the basement kitchen controls the movement of these cars and dispatches the dumbwaiters to the various floors in accordance with demands or signals received from the floors. These signals are indicated on the annunciator in the basement kitchen. The dumbwaiters run at a speed of 500 ft. per min. and are capable of carrying a load of 100 pounds.

## Storing Coal With a Fan

BY H. H. FINCH

The following method of handling coal for storage at our plant may be of interest to readers of *Power*. The illustration tells the story. This machine is made from an old blower, and it will handle coal faster than four men can feed the hopper. We had for several years been storing coal on a lot about 200 ft. square and a number of men were generally employed in wheeling it back. This was slow and expensive, and in order to eliminate useless work and expense I had some 10-in. diameter pipe made from No. 16 iron joined together end to end, each end being flanged and fitted with a collar for the purpose of securing the pipe lengths together so that they would not work loose. The tee to which the hopper is secured is made of cast iron.

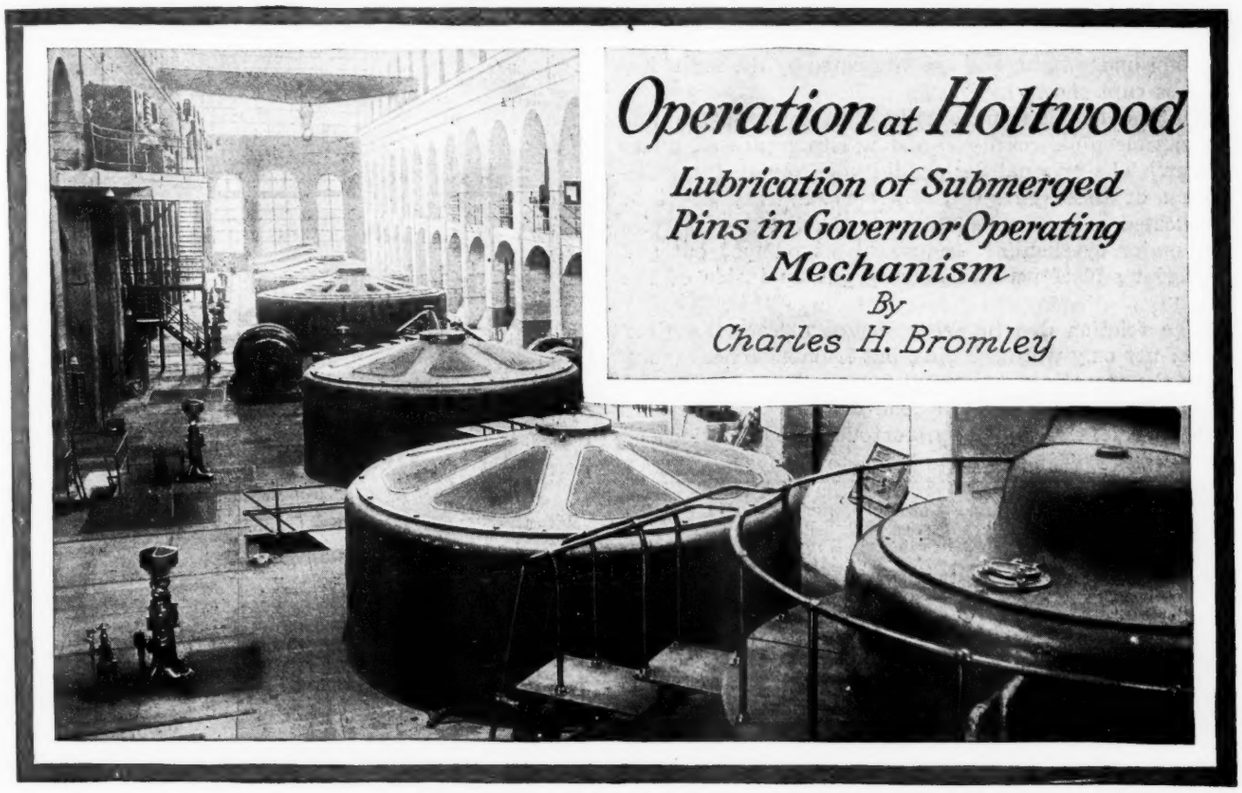
In order to keep the coal on the lot a back-stop was put up, but this did not stop the dust, so a hole was




MOTOR-DRIVEN BLOWER FOR STORING COAL

made about two feet from the discharge end of the pipe and a hose nozzle so inserted as to spray water against the air blast, which broke up the water into a fine mist and mixed it with the coal.

The pipe was about 70 ft. long in 10-ft. lengths. The blower is driven by a 25-hp. motor, and the coal is stacked from ten to twelve feet deep. It can be stored at a very low cost with this machine.



# Operation at Holtwood

## Lubrication of Submerged Pins in Governor Operating Mechanism

By Charles H. Bromley

FIG. 1. EIGHT GENERATORS RATED AT TOTAL OF 83,500 KW. AT HOLTWOOD ON THE SUSQUEHANNA

WEAR and corrosion troubles in the link pins, vane pins, reach-rod and wristpins of the double-runner units have been overcome by the use of monel metal for these pins. Micarta bushings are now being tried, and experience so far indicates good results. The large submerged pins, which originally had no lubrication other than that given during periodic overhauling of the turbines, are now lubricated from the turbine-room floor by means of a grease gun from which a separate pipe runs to each pin. These improvements have increased the interval between general overhauling of the units at least threefold.

Before the wheel of each turbine there are a number of wicket gates for regulating the flow of water to the wheel. These gates are moved by operating cylinders and their connections, the actuating water pressure being 275 lb. per sq.in. A partial view of the external operating mechanism as

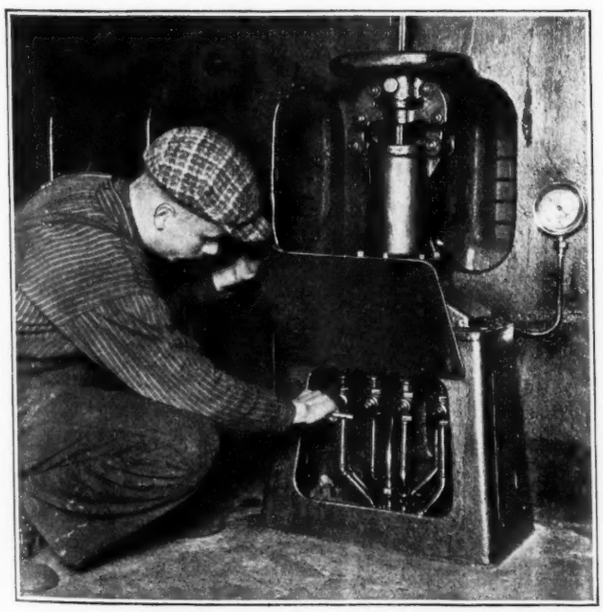


FIG. 2. FLOORMAN USING THE GREASE GUN ON THE TURBINE-ROOM FLOOR FOR LUBRICATING SUBMERGED PINS

FIG. 3. PUMPMAN GIVING PART TURN TO GREASE GUN SUPPLYING GUIDE-VANE LUBRICATION

applied to the new, or No. 8, unit is shown in Figs. 3 and 7. In this machine the pins for the wheel gates are not under water and are lubricated by the individual grease cups shown in Fig. 3.

On the double-runner units Nos. 1 to 7, the link pins, vane pins, reach-rod and wristpins are all under water. The original design did not provide for lubrication of these pins while in service; they could be lubricated only when a unit was taken out of service for major overhauling, the wheel pit pumped out and a working platform and rigging put up inside of the pit.

The friction due to gritty deposits from the river water not only wore the pins, but imposed a heavy load upon the operating mechanism for moving the gates and their connections. Besides, the corrosion of the pins was considerable and when corroded the coefficient of

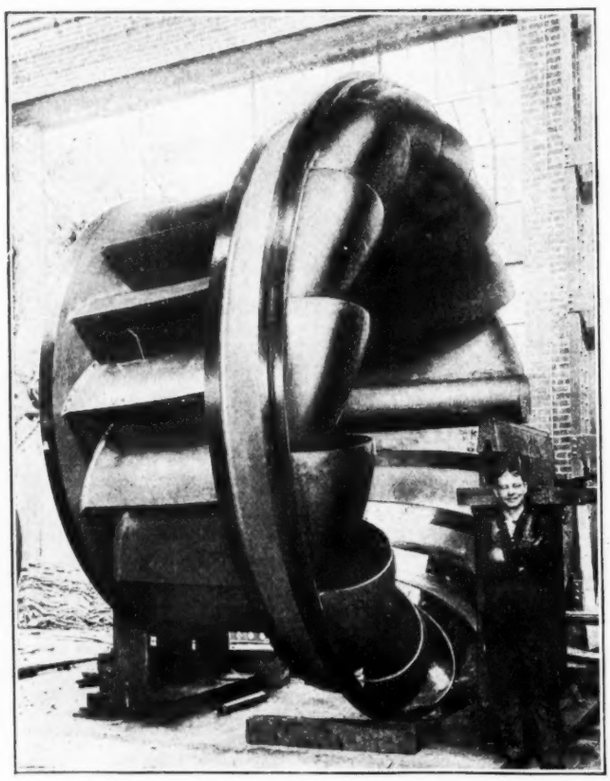


FIG. 4. RUNNER OF THE 17,000-HP. TURBINES

friction was affected accordingly and thus in turn the strains on the operating mechanism further increased. The wear is shown in Fig. 8, where some of the worn pins of the older type are contrasted with new pins. Such wear, if permitted to increase excessively, will produce considerable slack and lost motion, and inability to produce full gate opening. Vanes, with operating piston in completely closed position, will permit excessive leakage; governor action of the turbine and equal distribution of stresses in mechanism will be affected.

To overcome the trouble of excessive wear and corrosion, pins were first made to operate in bushings of different metals, such as brass, bronze, graphitized metal and other alloys; zinc-impregnated pins were tried, but the expected electrolytic action ate away the zinc too quickly. Experience showed that lubrication was necessary on the larger pins and a grease gun was designed, by means of which properly graded lubri-

FIG. 5. CORRODED STEEL PINS CONTRASTED WITH MONEL PIN LONG IN SERVICE, SLIGHTLY WORN BUT NOT CORRODED

cant can be forced directly to these pins from the turbine floor. Looking at Fig. 2 a number of ½-in. pipes, each leading to one pin only, can be seen. Each pipe has a cock at the point where it leaves the chamber of the grease gun. One cock is opened at a time,

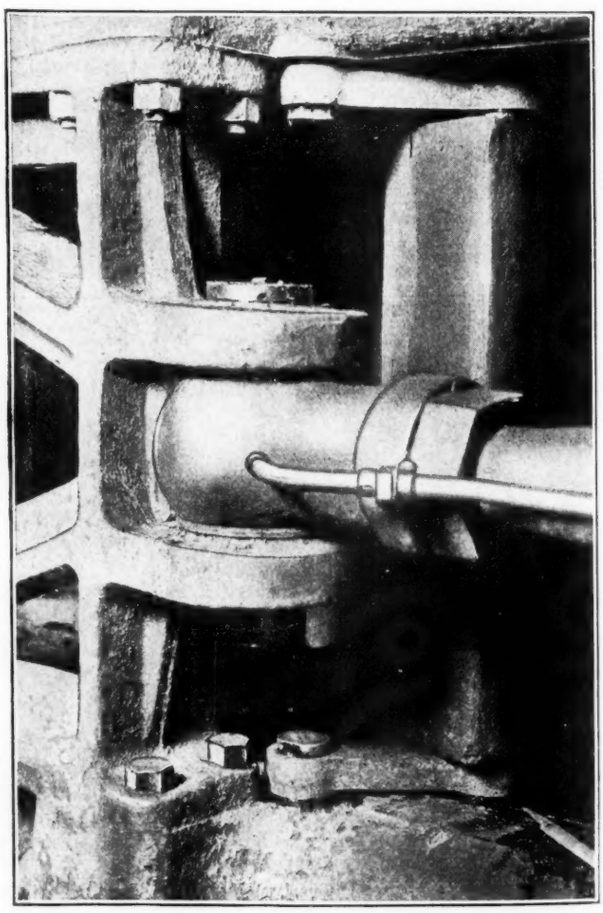
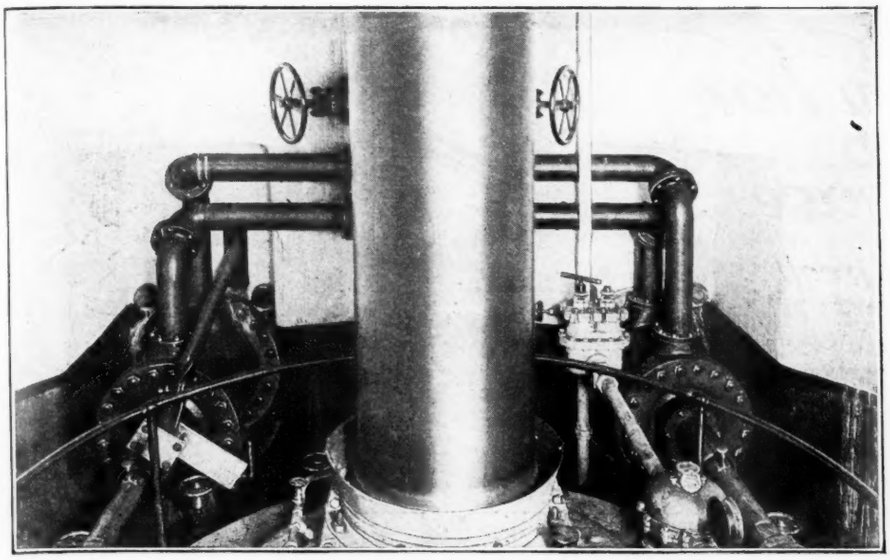


FIG. 6. INDIVIDUAL GREASE PIPE TO SUBMERGED REACH-ROD PIN



For the smaller-sized submerged pins monel metal has been found, so far, most suitable to resist wear and corrosion under Holtwood conditions. Micarta bushings have also been experimented with recently, on pins operating under light specific pressure, with apparently good results, but have not yet been sufficiently long in service to permit of any definite comparisons. While, formerly, main units required thorough overhauling approximately every two years, the results so far obtained from the foregoing improvements promise to increase the interval between overhaulings at least threefold.

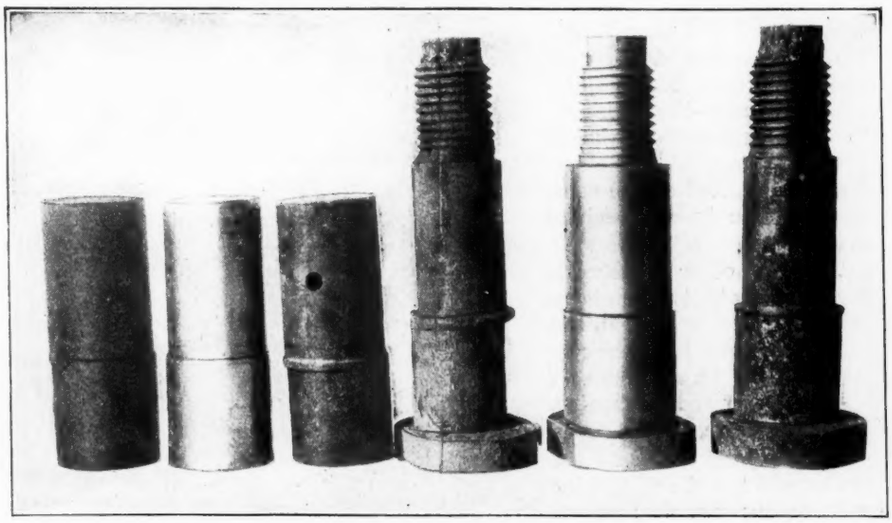
FIG. 7 (ABOVE). ARRANGEMENT OF TWIN OPERATING CYLINDERS OF SINGLE-RUNNER UNIT

Note on cylinder to the left the attachment for indicator to record lost motion and operating pressures.

FIG. 8 (AT THE RIGHT). SHOWING WEAR OF THE SUBMERGED LINK PINS AND VANE PINS

Old steel pins contrasted with new monel pins. Note corrosion of the old pins.

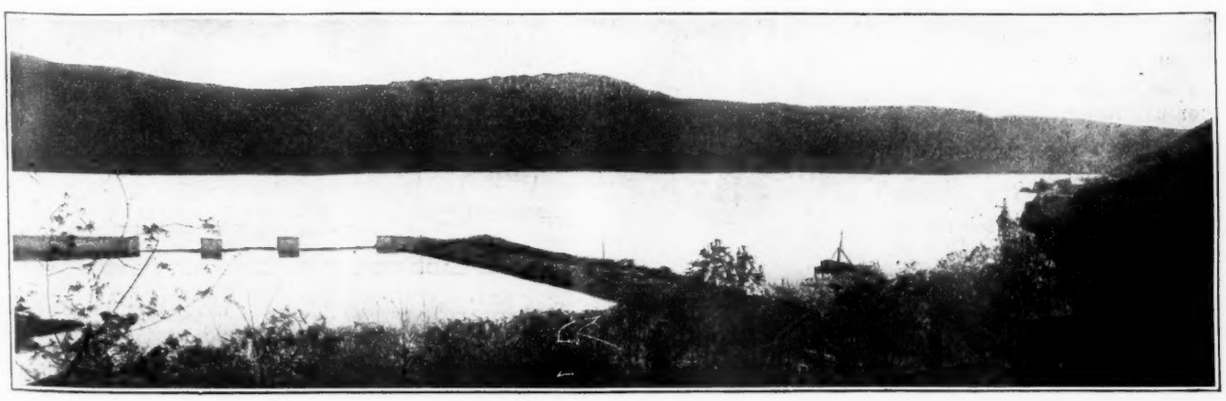
FIG. 9 (BELOW). VIEW OF THE "LAKE" AND FOREBAY FROM ATOP THE 360-FOOT HILL AT HOLTWOOD



and the handwheel actuating the piston in the gun cylinder is given a certain fraction of a turn within stated intervals.

After several years of service these grease guns have resulted in a very appreciable decrease in the maintenance of these parts of the turbine. The former necessity of increasing the governor pressure has passed, and better regulation of turbines and a number of other incidental advantages were secured.

During the high-flow months the regular maintenance force keeps track of the conditions of the unit as to lost motion, leakage, operating resistance in mechanism, etc. A standard Crosby steam indicator is used for that purpose, and the results are plotted on an inspection chart that shows at a glance how lost motion, operating pressure, etc., are affected from year to year. This chart serves then as a guide to decide which unit should be selected for the overhauling work.



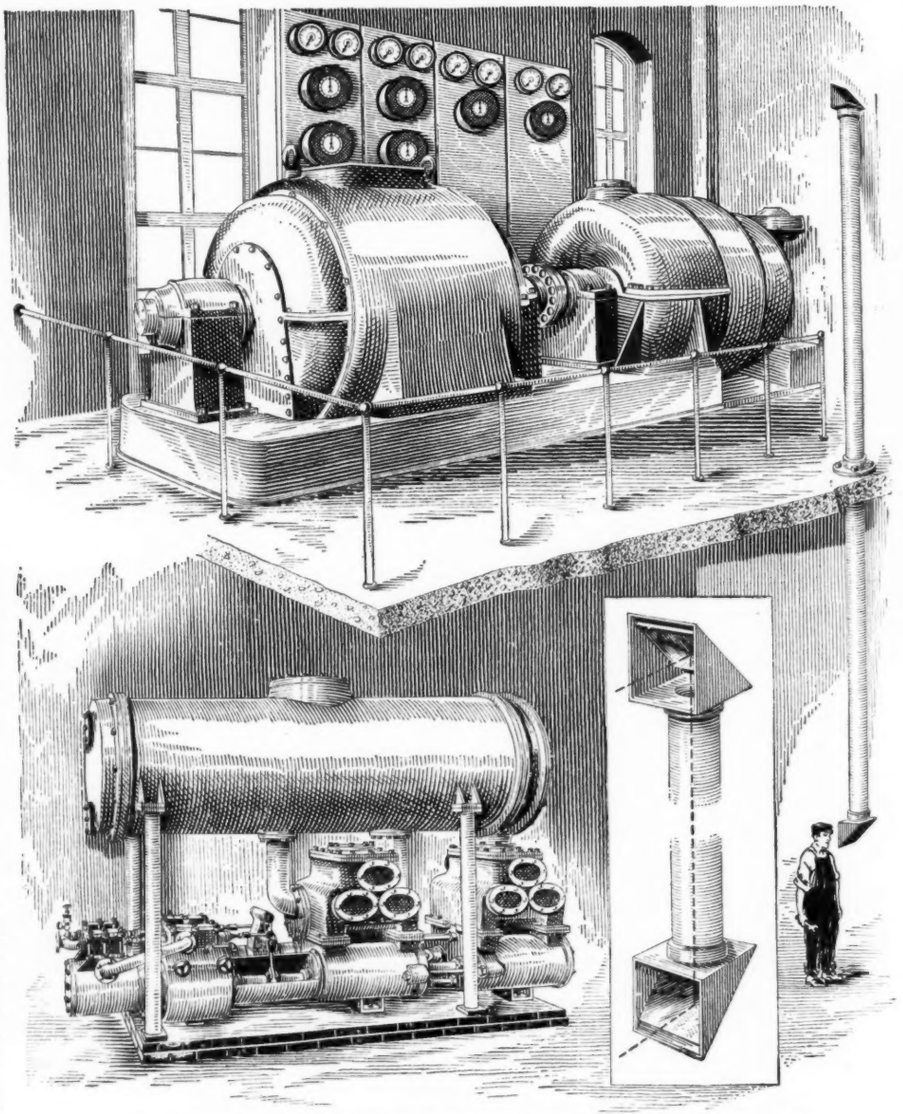
# Periscope in War and Peace

by J. M. Purcell

THE following idea illustrates how one engineer succeeded in making a convenient instrument for himself, using a device that had made the U-boat the terror of the sea—the periscope. The periscope enabled the U-boat to remain below the surface unseen, and at the same time observe its approaching prey.

The use of a home-made periscope enabled an engineer to do his necessary repairs in a basement and to observe at intervals his instrument board, on the mezzanine, about fifteen feet above.

In this particular case the instrument board and turbine were on the mezzanine floor, and the condenser and various other machinery on the main floor. For his convenimain floor. For his convenience, the engineer took a leaf constructed a simple periscope as illustrated. It was made out of some old 3-in. fiber conduit, two mirrors and a housing to contain the mirrors. The same principle can be used in more difficult situations than the one described, by using the necessary number of mirrors. To make the device successful, the object to be observed should be intensely lighted. The mirrors should be at an angle of 45 deg. with the center line of the conduit.



HOW THE PERISCOPE WAS MADE USEFUL IN A POWER PLANT

This device is a convenience for the engineer of a small plant, because if his duties demand that he remain in the lower part of the plant, he can watch his instruments without going to the upper level. The device is simple and anyone can make one at small expense. Such an instrument would come in handy in some boiler rooms where the water glass is located high above the floor level and dimly lighted at that.

# Spike McNally's Nonexploding Flywheel

By E. E. CLOCK

SPIKE McNALLY, as he was known to his friends, was chief engineer, master mechanic, blacksmith, millwright and electrician for the company and, if tradition runs true, he never got stuck. It was while I was in the little four-by-nine office of the superintendent of the Victory Mining Co., in southeastern Kansas, that I made his acquaintance.

Spike came into the little office and, as Mr. Sutton, the superintendent, turned toward him, he said, or rather exploded, "Say! where in the name of all that's holy did you pick up that bunch of bums and hobos that you sent me for firemen?" And as the roof of the little shack rose up and settled again, he took breath for a fresh blast and continued: "Those fellows couldn't fire a haystack soaked with gasoline," and as the window panes cracked, one after the other, he went on: "There ain't any one of them knows as much about firing as Bill Brine knows about steering the Ship of State. We've got to get some different men down there or that boiler house will be making ice and the North Pole will be a summer resort alongside of this place before morning." With that he went out, and as he pulled the door shut, the front of the little office bent outward visibly.

The superintendent turned to me and said: "He ain't got no use for a wireless telegraph. If he wanted to commune with President Wilson in France all he'd have to do would be to stick his head out of the window and let loose with that voice of his'n; they'd hear him. He'd crack the glass in the Royal Palace worse than Big Bertha. If he comes in here again and opens that bazoo of his'n, I'll take him by his breath and pull his lungs out."

"Well," I said, "you'd better get a bucket to put them in for here he comes now." And as I spoke Spike stuck his head in the door and yelled: "It's a damn good thing those bums can't make steam. They'd blow this shebang to kingdom come. One minute the water is halfway up the smokestack and the next it's way down in the sewer," and with that he withdrew his head and sprang the door casing some more.

The superintendent turned to me and said: "He don't like them firemen."

"I was just beginning to surmise something of that sort," I said. "Are they as bad as he paints them?"

"Well they ain't what you would call experts—most hobos ain't—but you got to discount about half of what Spike says to get things right. But let me tell you one thing—they will be experts if they don't hop the rattlers before he gets them trained, and it won't take him long either. He'll put them through a course of sprouts that'll graduate them to Spike's way of doing things in jig time, and if they have a rugged constitution and last long enough to graduate, some other cuss will win them away with more pay like enough, and if you are around here about that time you will think Spike was only whispering today."

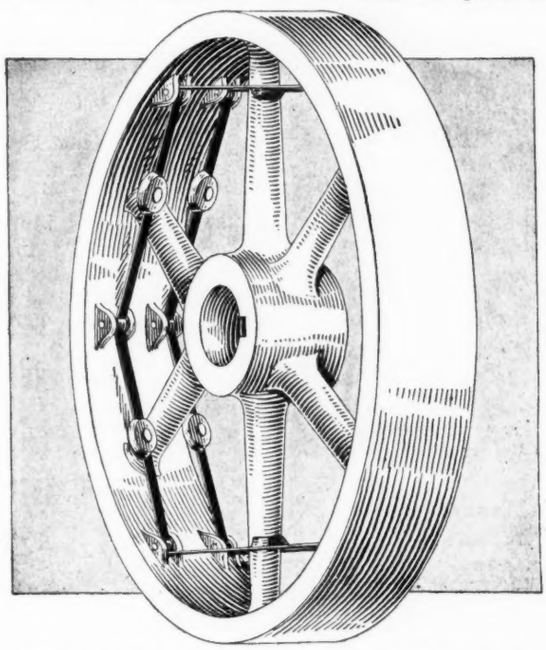
"Is Spike a good mechanic?" I asked.

"None better in the county," answered the superintendent. "Why, any time they get stuck anywhere around here, they send a buckboard after Spike and he fixes them up every time; and it don't make any difference what they stack him up against, he never gets stuck. You see this electric light here? Well, he made the dynamo that makes that light. We had kerosene lamps around here, and one day when the president of the company was down from New York, Spike asked him for a dynamo. 'Can't afford it,' said the president. 'Why, it would cost a thousand dollars.'

"'Great balls of fire! I can make one that won't cost a hundred,' retorted Spike.

"'Why don't you?' asked the president, and then he laughed up his sleeve, which was a habit he had when in the presence of an extra-good joke of his own hatching. But the next time he came down he had to laugh up the other sleeve, for Spike had the thing finished and running and we had an extra illumination for the occasion. Spike was lit up himself that night slightly, and after the president had been out and seen the dynamo, he pulled his checkbook out and says to Spike: 'Well, what size check will it take to cover you for the material you bought?'

"Spike said, and you could a'heard him to Texas: 'Keep your money, Mr. President. Maybe I won't stay here always and when I go she goes with me.' You see Spike went over ten miles to a place where they used to haul ore on a trolley line, and there was a lot of trolley wire out in the weather and he wired up this place with



SPIKE McNALLY'S NONEXPLODING FLYWHEEL

it, made wooden cleats and everything, and it is just the dandiest thing you ever saw. I wouldn't have covered wires after seeing this outfit. Why, when anyone wants a light any place, all he has to do is to have a lamp and socket and a pair of short wires to hook across the leads and up she lights."

"What's the voltage?" I asked.

"Fifty," said the superintendent, "and that's plenty."

"What does he do for fuses and such things?" I asked.

"Fuses?" said the superintendent. "Why, they ain't one on the place."

"How about short-circuits and overloads?"

"Why, the belt comes off the dynamo or the little engine that drives it gets stalled."

"I guess he must be quite a genius," I said.

"You said a mouthful," rejoined the superintendent. "You don't have no idea. Sometimes I think he is so full of it that he is kind of looney. Why! we had a lot of ore-dressing machines here that couldn't keep up to the big crackers and kept getting swamped with ore all the time, and we speeded them up and speeded them up till we got them where they could handle all that came down the sluiceways and then we were up against another trouble—the darn flywheels kept busting. One day one of them winged a greaser and came near killing a good mule. We couldn't slow them up without going back to our first trouble, and so we sent for a man to come out from the St. Louis shop, where they were made, and when he had checked up the speed and found it 'bout a mile and a half a minute on the rim and had sized Spike up for a hick, he began to spit figgers and rules and preached a nice little sermon on centrifugal force, etc., and said no one could make a flywheel that would stand that speed; and if he had been the lord high chief of the soupreem court, he couldn't have laid down the law any better on margins of safety, coefficients, tangiental efforts, etc. Well, he preached that stuff to Spike till it kind of got on his nerves, and Spike said:

"'So you can't do anything to stop them wheels from busting, hey? Can't fool this here centrifugal force so as to make it reverse itself and hold those wheels together? Couldn't vaccinate them wheels with centrifugal force so as to cure the original disease or leastwise use some of this centrifugal force to keep the wheels from busting?'

"The St. Louis man looked at me and then at Spike and estimated the jumping distance through the window in case Spike got violent, and passed his hand over his eyes kinda like a man in a dream and edged toward the door, and Spike said: 'Well, I can, and I'll do it, too.'

"Saint Louey got one hand on the door knob and he said: 'When you do, I'll go up and drive a nail in the moon to keep it from falling.'

"Spike said: 'If I make up a sketch of such a wheel and if the sketch shows plainly that it will do just as I have said, will you make us up one for each of those machines?'

"'Yes, and nickel-plate them besides,' said the St. Louis man, quickly.

"'Mr. Sutton, get that in writing while I make the sketch,' said Spike.

"The Saint Louey fellow readily wrote his own scenario and signed it, and in about ten minutes in came Spike with the sketch and handed it to him with the remark:

"'There is your vaccinated flywheel. Make us up one for each machine and if they don't collapse from the high speed we're running, I ain't afraid of them busting.'

"The man sat and looked at that sketch like he had took dope, and finally he woke up and he said: 'I guess he's got me, by cracky! It'll do it, sure as guns! Wait till the office sees this sketch and the contract I've signed'!

"Well, they were game and they made them up, and they have been running five years and you couldn't bust them with any kind of speed.

"They only required the ordinary pattern to have four lugs cast in the middle of each arch, two on each side, about two and a half inches apart, through which short pins were put with a piece of thin pipe for a roller; then an endless band of strong but thin steel was strung under these rollers one on each side of the spokes, you understand, and small cast-iron weights were riveted in the bands as shown, one of them being used as a splice for the band. As the speed increases, the weights tend to go out away from the center and exert a strong inward pull on the pulley arches right where it is needed. It was so simple and worked so well that those Saint Louey fellers came up here and took a lot of pictures of them; and after they had all the pictures they wanted, they risked the camera on Spike, too. I listened for the sound of falling glass, but nothing happened, and so I say Spike has got some funny old gray matter in that head of his."

## Improved Green Chain-Grate Stoker

A general view of the improved Green chain grate would have much the same appearance as the stoker the Green Engineering Co., of East Chicago, Ind., has been making for over 20 years, but beginning with the driving mechanism there have been radical changes. Although the steel spur-gear drive has been retained, the gear frame and cover have been combined as shown in Fig. 1, eliminating joints and strengthening the construction. The side girders, of heavy design and of channel-shaped section for strength and for freedom of air supply, are located eight inches below the fire line.

Another improvement is the use of chain skids to support the upper and lower leads of chain in place of the former pipe-roll construction. The skids are constructed of rails with hardened heads to resist wear. The ends are curved to receive the chain from the sprockets at the front. As shown in Fig. 2, the skids are supported by transverse I-beams connected to the side girders. The grate is held level and there is no sag between rollers to open up the spaces between the links. It is claimd that the siftings have been reduced to less than one-third of the amount passing through when rolls were used.

The gate-operating mechanism now employed consists of a steel cut-worm and worm gear turning a pipe resting in trunnions and to which the gate is attached by means of chains, as shown in Fig. 3.

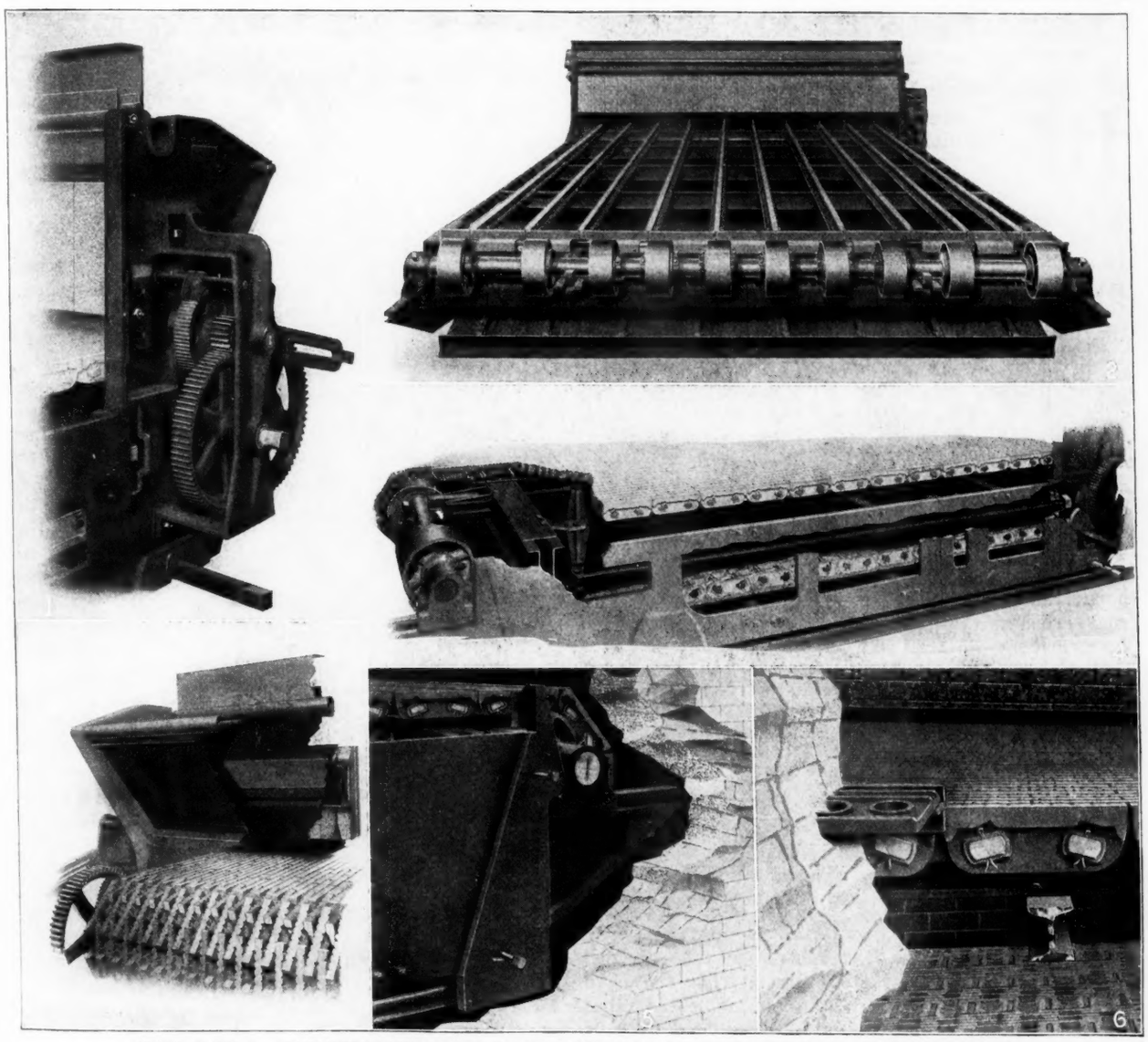
At the fire line the side frames of the stoker are protected by cooling plates consisting of small castings with air circulation between them and the side frames. The cooling plates extend around both sides of the frame and prevent overheating.

On the rear shaft, as shown in Fig. 2, plain drums are used instead of sprockets. The drums afford ample bearing surface and also tend to prevent climbing of the chain at the rear. On stokers 7 ft. 6 in. wide and over, the intermediate shaft of the driving mechanism is carried across the stoker and there is a pinion and drive gear on both sides of the stoker to eliminate

torsion in the sprocket shaft or lagging of the stoker chain.

An ingenious improvement is the adoption of a tension take-up at the front. Fig. 4 shows the idea. All adjustment is made at the front from the outside of the boiler setting. The operation consists of adjusting a brass nut at the end of a tension rod at either side of the stoker. At the rear the mechanism consists of a rocker arm with a fulcrum at the center secured to the rear girder. At one end is attached the tension rod running to the front of the stoker and at the other end a rod communicating with the rear shaft at the quarter point. At the other side of the stoker this mechanism is duplicated. Tightening up on the tension-rod nuts pushes back the rear shaft, which is mounted on rails and is free to slide. This operation takes up the slack in the chain.

Air exclusion at the rear of the stoker and along the sides is thorough. Between the chains and behind the rear cross-girder is a heavy damper with swinging cast-iron sections at the top and bottom. This damper makes contact with the upper and lower leads of chain. Between the side girders and the brickwork the air seal is effected by dampers, as shown in Fig. 5. This damper is formed by a flange upon the side girder shouldering against a companion flange bolted to the furnace side wall. Adjustable ledge plates and flanges, Fig. 6, make a seal between the stoker chain and the furnace brickwork. The plates and flanges are in 3-ft. sections and can be adjusted to make close contact with the chain. This type of air seal permits the raising and lowering of the rear of the stoker to produce varying heights of ash discharge.



FIGS. 1 TO 6. ILLUSTRATING SOME OF THE DETAILS OF THE IMPROVED GREEN STOKER

Fig. 1—Stoker-driving mechanism. Fig. 2—Chain skids and rear drums replacing sprockets. Fig. 3—Coal side of fuel gate. Fig. 4—Front tension take-up. Fig. 5—Side girder damper. Fig. 6—Adjustable ledge plates.

Pressure water-backs complete the seal between the fuel bed and the bridge-wall. They are connected into the boiler circulation, are circular in section so that they may be turbined and are free to expand and contract. Below the lower chain, air from the front is baffled off by means of a transverse damper attached to the lower sides of the stoker. With this system of seals practically all air entering the furnace must pass through the fuel bed.

# Economies in a Mine Power Plant

By J. A. CARRUTHERS*

*In the power plant in question a reduction of thirteen to fifteen tons of coal per day was made in the fuel used as a result of several changes in the equipment. This coal, in contrast to the usual coal-mine power-plant fuel, was a high-grade steam coal and could in no sense be classed as a drug on the market.*

BRIEFLY, the power plant consisted of eleven return-tubular boilers with a manufacturer's rating of 150 hp. each, and 104 hp. government rating. Taking the former rating and allowing one boiler off for washing, the total was 1500 hp. The power house contained three air compressors and two generator engines, all of the compound-condensing type. The generator engines were operated alternately, twenty-four hours. The total indicated horsepower of the four units under regular running conditions was 1425 to 1475. In addition there were a couple of service pumps and four jet condensers to operate. Outside the power plant were several engines used for fans, hoists, shops, coal-crusher, car-loaders, etc., which totaled about 300 hp. This added to the power-house load total made an average of 1750 hp. The air compressor load would often increase 30 to 50 per cent. for days at a time, owing to the demand for air in the mines.

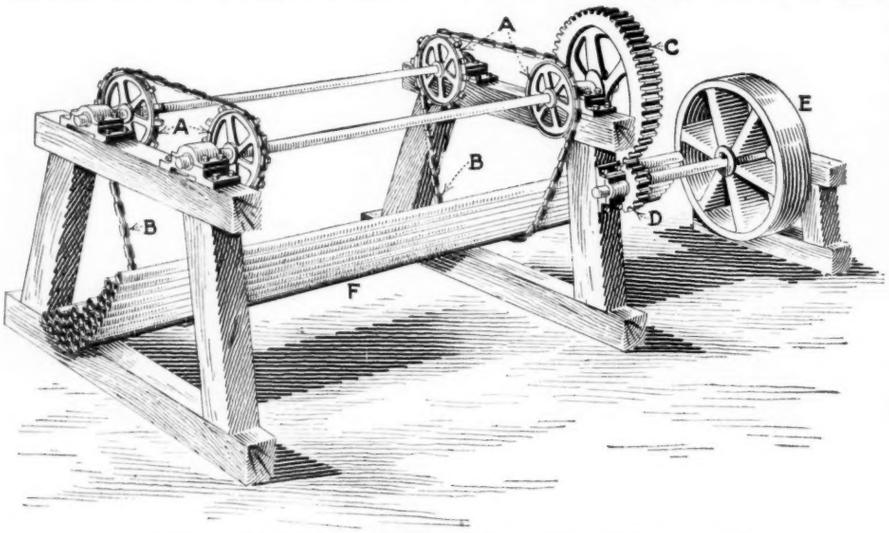



FIG. 1. RIG FOR REMOVING SCALE FROM BOILER TUBES

Several of the boilers leaked badly at the rear end of the tubes, and examination proved that they had been rolled to a finish. A hard scale inside the tubes extending about a foot from the head was one effect of the leakage. As these same boilers were badly scaled inside on the back head and a portion of the tubes, four of the worst ones were cut out and retubed.

With tubes at war prices new ones were put in the first boiler only. The old tubes in the meantime were cleaned with the home-made rig shown in Fig. 1 and then welded up for use in the next boiler cut out. In replacing them the new ends were put to the back end of the boiler. New tubes at that time cost about $11 each, and there were 70 to each boiler. The cost of welding up the old ones averaged about $3.20 each.

These boilers, in common with most others of their type, had the grates set a bare two feet below the boiler shells. This gave very poor furnace conditions for the coal used. To make these conditions worse, the bridge-wall had been built to conform to the curvature of the boiler shell, and at a distance of from ten to twelve inches from it. The result was that the gases were deflected against the relatively cool boiler surface before they had much chance to burn.

As a remedy for this poor furnace design, the grates were lowered considerably, as shown in Fig. 2, and the bridge-walls were rebuilt flat on the top at a distance of about 16 in. from the shell. The added furnace volume and free passageway afforded the burning gases to the back combustion chamber combined to give a much higher furnace efficiency. The increase in temperature was proved by the shorter life of the firebrick; also, the less amount of coal fired was soon noticed.

In lowering the grates, it was decided to replace the cast-iron fire-door arches and deadplates with firebrick. These castings cost between $70 and $80 to renew about every five or six months. This price refers to the cost of renewal of the castings per fire-door.

The boilers had individual steel stacks with no dampers fitted, so that the only draft regulation was by means of the ashpit doors. These were badly warped, and most of them would not close at all. Besides, this regulation was of no use when cleaning fires. As hand firing was used, at cleaning time the cold air rushed through the setting with full draft intensity, causing a considerable drop in temperature. To remedy this, as each boiler was cut out for washing, a damper was fitted to the stack and the adjusting rope dropped within convenient reach of the firemen. After these were installed, the firemen were instructed to nearly close them when cleaning fires. It also gave some control over the fires if one of the large engines happened to shut down unexpectedly, and less coal went through the pop valves in the form of steam. The cost of making and installing the dampers was small.

Before finishing up in the boiler house, about $300 worth of a good quality of pipe covering was put on the 16-in. steam header above the boilers in place of the original covering, which was of poor quality. The covering on top of the boilers was also overhauled and put in good condition by the use of some old plastic covering taken off an old, unused steam line. This class of covering will stand remixing and make a good job.

*Master mechanic C. P. R. Mines, Lethbridge, Alta., Canada.

The boiler settings were also gone over and all air-holes and cracks in the brickwork were plugged.

One of the largest single losses around the plant was caused by the location and design of the steam header serving the power-house engines, etc. This header included about 125 ft. of 16-in. o.d. pipe, and 75 ft. of 12-in. pipe. There were also several 6-in. and 8-in. branch pipes leading to the various engines. All this piping was installed outside and directly under the drip off the roof. The large 16-in. flanges had never been covered, and the covering on the pipes was poor. Nearly every flange leaked at the threads, and the condensation, as shown by the leaks, was extremely high, as was to be expected in a locality where the temperature takes big drops for days at a time. The header, as installed, required 60 to 70 per cent. more pipe than if it had been put up inside the power house.

As it was impossible to make any repairs to the header and at the same time keep the plant in operation, a new header was installed inside the power house. It was made up of pipe on hand and a few of the fittings out of the old installation. Instead of making the new header of 16-in. pipe, which was large enough for three or four power houses of the size served, pipes 12, 10 and 8 in. in diameter were used. This reduced size also facilitated drainage owing to the increased velocity of the steam. Sufficient lagging to cover the new header was secured from some old unused boilers. It was in slabs 6 x 36 in., but by splitting into 3-in. widths it made first-class pipe covering.

One of the two tandem-compound generator engines was in bad condition owing to the low-pressure piston and cylinder having worn enough to let the piston rod

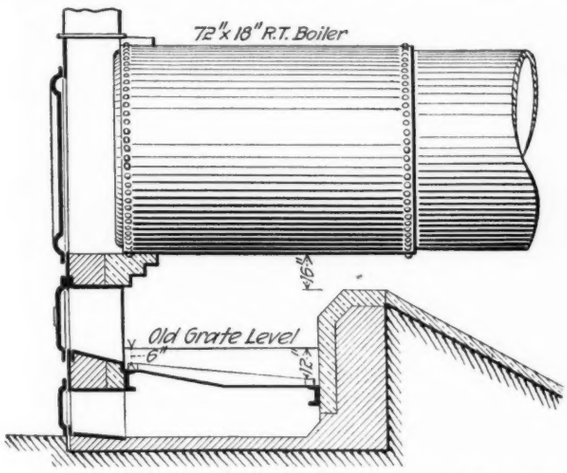



FIG. 2. BOILER SETTING SHOWING OLD AND NEW GRATE LEVEL

drop about one-eighth of an inch. The engines were of the horizontal type. This was remedied by fitting the low-pressure piston with two bronze wearing rings, and all four packing-boxes with bronze neck-bushings. New piston rings were also put on, as the old ones had been passing steam badly. The low-pressure cylinder should have been bored out, to make a first-class job, but at the time the work was being done it was impossible to risk stripping the engine. While the low-pressure piston was being machined for the rings, the engine was run on the high-pressure end only and carried the load all right. After over two and a half years' running the piston rod on this engine had dropped again only a distance of 0.008 inch.

The other generator engine had a bent piston rod and badly worn piston rings. These were renewed and the piston given a one-quarter turn to bring the wear on a new section of the wearing rings.

There was between 15,000 and 16,000 lin.ft. of 1-in. pipe built into heating coils in the washhouse. The condensation from these coils had been allowed to blow to waste through a hand-regulated valve. Of course the valve was always left open enough to insure draining the coils "in case it happened to get a little colder."

To get the benefit of this condensation for feed water, a good steam trap was connected up to the outlet

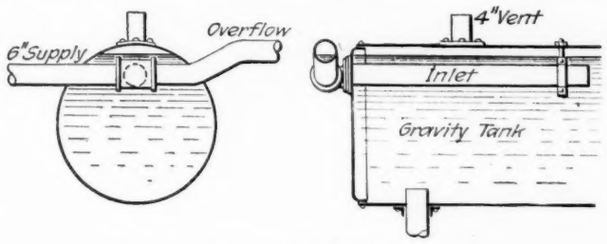



FIG. 3. PIPING TO GRAVITY TANK

header of the coils. A bypass was also included, and in case the trap got out of order during the night, the watchman simply regulated the drainage in the same way as before. The hot returns were discharged into a tank that fed by gravity into the open feed-water heater; some particulars of the connections to this tank are given later on.

The trap used discharged about two gallons per dump, and the writer often counted the number of discharges at twice a minute on the coldest days, down to once every four or five minutes on the average days. This was a big difference to steam blowing steadily through the old drain valve.

With about 600 men washing daily in this washhouse, a large amount of hot water was required, and a large amount was wasted. This water had always been heated by live steam in an overhead tank. To make it worse, the tank usually overflowed "to make sure that there was plenty of water." To cut out this waste, the live steam was shut off and the exhaust from one of the boiler feed-water pumps turned in. As one pump was always in operation, there was no chance of the exhaust being shut off for any length of time.

In making the change of piping to this hot-water tank, the queer ideas of some men with regard to simple questions in engineering were forcibly brought home. Someone in former years had put a large steam coil of 2-in. pipe inside the tank, with the drain of the coil piped outside to a trap on the ground below. The trap froze up one night and the coil broke at a return bend. After that the coil was allowed to drain into the tank through the break.

A cold machine shop is about the poorest place on earth to get any work done. The heating of the shops in this plant had been done by stoves, but no one seemed to think that the heating really had been done.

To make it right, steam coils of old 2-in. pipe were put around practically the entire walls to a height of about three feet from the floor. A connection was then made for the exhaust steam from the shop engine to be used during working hours. At nights and at other times when the engine was not running, live steam through a reducing valve was used at about 10 lb. pressure. To prevent any chance of the coils freezing up due

to drain valves being left closed, and also to eliminate any fussing in adjusting the opening of these drains, a hole about $\frac{3}{16}$ in. in diameter was drilled through the gate of each valve. In the mornings the shop boy shut off the reduced steam, then opened the drain valves wide and turned the exhaust steam into the system. At nights he reversed the procedure, and instead of having to set the drain valves to a required opening, he simply shut them. The small holes were sufficient to keep the coils drained with the pressure at ten pounds. Of course there was a little steam wasted in this way, but simplicity and reliability were the most important factors in this case.

Exhaust-steam heating was also put in two of the fan-engine rooms and locomotive sheds. As the fan engines ran 24 hours a day practically every day in the year, conditions were ideal for exhaust heating. Before the heating coils were installed in the engine rooms, there was difficulty in keeping the oiling system in operation on cold days.

To provide for a uniform head-pressure to the water going to the feed-water heater, an overhead tank composed of an old boiler shell had been installed. This was good as far as it went, as every engineer knows how much better a heater float-valve works with a uniform pressure than with a varying one. To supply the tank with water, the air-compressor jacket water had been piped to it and entered at one end and overflowed at the other. As this system would waste the hot returns from the steam traps at the washhouse and the power house, the traps being piped to discharge into the tank, it was decided to change the jacket-water piping in such a way that the tank would not overflow and yet keep a uniform water level.

It was first intended to use a float valve on a branch pipe from the jacket-water outlet header to supply the tank. However, after considering the natural troubles that go with most float valves, and trying one, this method was passed up for simple piping system shown in Fig. 3. The solution was so extremely simple that it is surprising that it had not been thought of sooner. The idea may be of use to someone wishing to use all or a portion of some waste water.

As some of the outside steam pipes were leaking badly, they were overhauled and thoroughly covered for below-zero weather. One old line about one-third of a mile long, was made up of 8-, 6- and 4-in. pipes and apparently all the different fittings that could possibly be connected up. It was jogged up and down and sideways, and had several good water pockets that furnished periodic slugs to the engines it served. Several hundred feet of the 4-in. size was laid on the ground alongside of the car track, and had been found very handy to get rid of snow shoveled off the track. This and the rain had soon fixed the pipe covering.

This 4-in. section was relaid on trestles and properly covered. It was given a 1 per cent. grade and a steam trap connected at the far end for proper drainage. The other part of the line, which had so many fittings and jogs in it, was replaced by a new 6-in. line. Bends were used instead of the three or four slip expansion joints. These joints had been the cause of several shutdowns of the fan engines to allow them to be repacked. The water lying in the line seemed to make the life of the packing uncertain, and the result was either bad leaks or a shutdown at the first opportunity. This was all the more annoying because the fan engines were run a year with only one stop of a few hours for keying up and packing after the new steam line had been put into use.

In going over a plant with a view to economy, it is well to remember that it is the accumulation of small defects and leaks that counts as a rule. In the plant under consideration, although the coal consumption was reduced, the output from the power house had considerably increased.

# Care of Heating and Ventilating Equipment—X

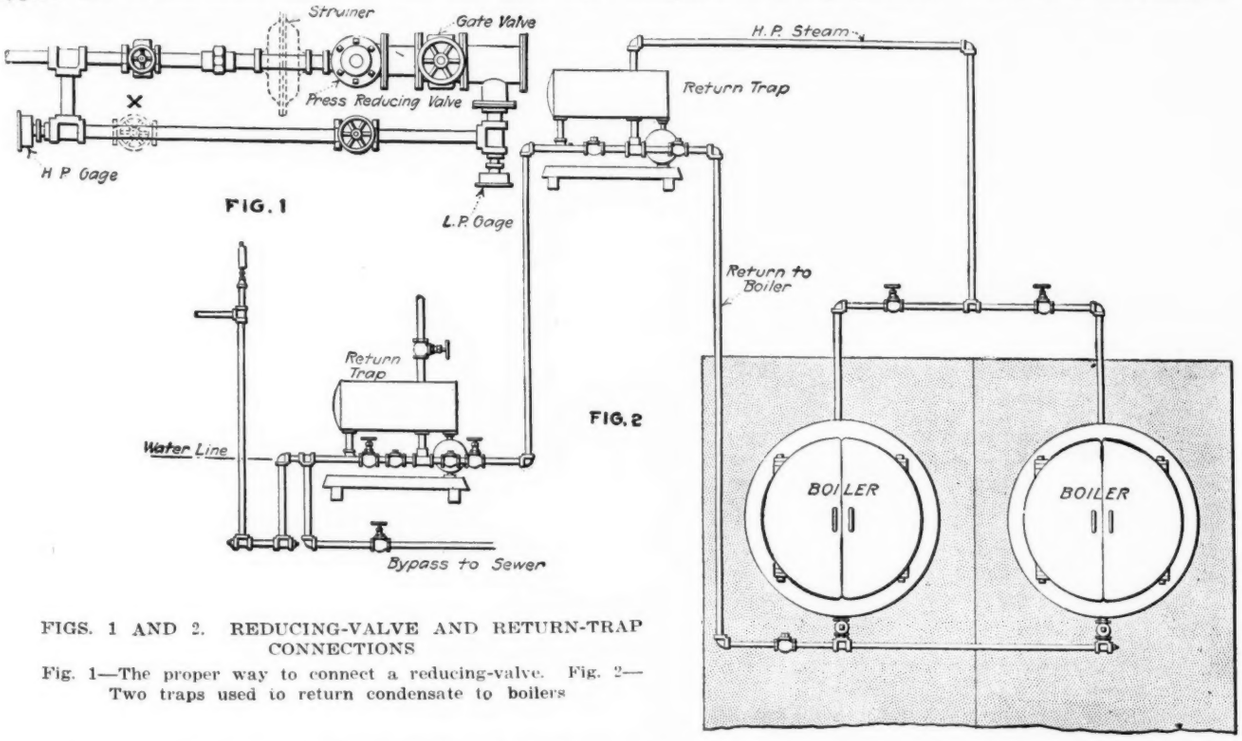
By HAROLD L. ALT

ANY heating system may be supplied with steam through a reducing valve instead of directly from a boiler, but the proper modifications must be made to care for the returns. To operate satisfactorily some sort of an automatic device is necessary to admit just sufficient steam to the low-pressure line to maintain the pressure there required—say 5 lb. gage or less. This is accomplished by a pressure-reducing valve which is closed by the pressure in the heating main when it becomes greater and opens when the pressure becomes less than that for which the valve is set. The action of a pressure-reducing valve is similar to, and in fact is, a throttle valve automatically controlled. The method or means of control varies in different makes and is usually either a diaphragm, differential or spring, or a combination of these means. The diaphragm type of pressure-reducing valve consists of a balanced valve the spindle of which is connected to a diaphragm. Movement of the diaphragm varies the opening to meet the demand for steam and is produced in one direction by means of a spring tending to open the valve while steam pressure in a chamber on the other side of the diaphragm, connected through a pipe to the low-pressure main, works against the diaphragm and spring and tends to close the valve. Thus the steam pressure on the diaphragm in one direction and the spring pressure in the opposite direction are opposed to each other, and any increase in the steam pressure tends to overcome the spring and close the valve.

The differential valve has two disks, one of small diameter and one of large diameter, mounted on the valve spindle in such a way that the high-pressure steam is against the small disk, tending to open the valve, while the low-pressure steam acts against the larger disk and in the opposite direction and tends to close the valve. Thus the pressure carried in the low-pressure main will be proportional to that carried in the high-pressure main, determined by the relative area of the two disks. A variable high pressure will therefore affect the low pressure. Spring-operated valves are counterbalanced by springs and the pressure in the low-pressure line combined. An increase in pressure closes the valve by assisting one spring, while a decrease in pressure allows the valve to be opened by the other spring. Weights are sometimes used instead of springs to oppose the action of a dia-

phragm in some types so that the farther out on the lever arm the weight is placed the greater the pressure that must be exerted under the diaphragm by the steam from the low-pressure main in order to close the valve.

It is best in installing a reducing valve to arrange the connections with a bypass as shown in Fig. 1, and if the valve is not supplied with an integral strainer a separate strainer, shown dotted, should be provided. In order to keep the close connections around the valve tight, it is considered essential by some that the bypass valve be located at a point exactly opposite the pressure-reducing valve, owing to the unequal expansion that otherwise occurs. For instance, suppose a bypass valve is located at *X*, the distance from the point of connection to the reducing valve is so much greater than the distance to the bypass valve that the difference in the temperature between the high-pressure and the low-pressure steam expands the main line more than the bypass due to this extra length. When the valves are opposite, the expansion in both the main line and bypass is equal. In any case, however, there should be adequate provision for expansion.




FIGS. 1 AND 2. REDUCING-VALVE AND RETURN-TRAP CONNECTIONS

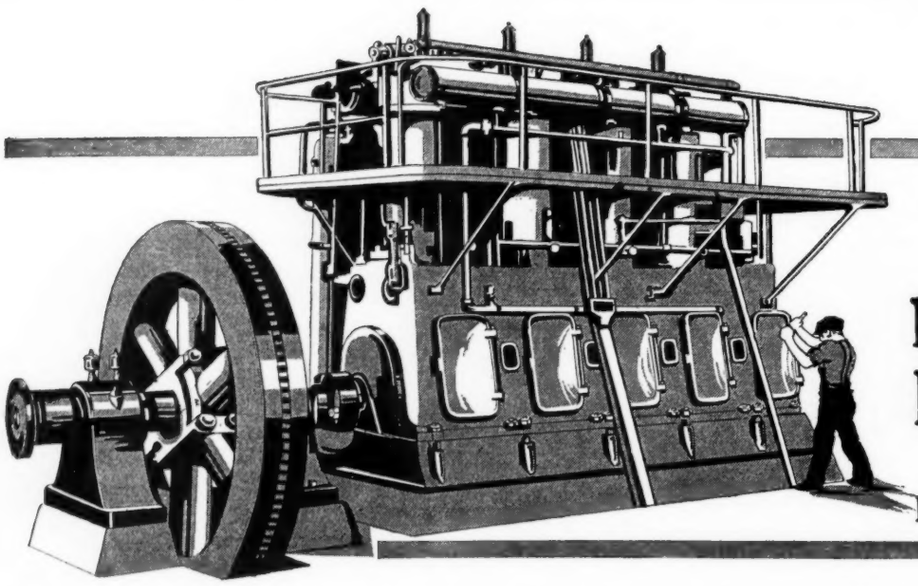
Fig. 1—The proper way to connect a reducing-valve. Fig. 2—Two traps used to return condensate to boilers

Having provided for a supply of steam, the other problem is to take care of the return. There are several methods of handling the returns, the chief deciding factor usually depending on how they can best be utilized in the particular case. Usually, the returns are discharged through a trap into an open feed-water heater, run to a receiver and pumped back to a suction tank or feed-water heater or are discharged through a trap to the sewer and wasted. It is possible to return the condensation directly to the boilers by the use of a return trap set well above the boiler line, as shown in Fig. 2. Automatic air-vent valves should be located on the return line to let out the air, for traps will not work if airbound. Condensation from a low-pressure heating system may of course be returned by an ordinary boiler-feed pump or a receiver pump taking its suction from a small cast-iron tank or receiver containing a float which controls the speed of the pump, starts it whenever the water reaches a given high level and stops it when the receiver has been nearly emptied. Such pumps may return the condensation directly to the high-pressure boilers, but usually return it to an open feed-water heater or reservoir. Sometimes where water is cheap or where the cost of getting the return water back is greater than the heat contained in it is worth, it is allowed to discharge through a trap to the sewer. This is not economical, however, from an engineering viewpoint. This trapping may be done by connecting all the radiators to a common return line and placing a trap at the end of the line, or the radiators may have individual traps and their returns connected in groups, leaving the return line open to the atmosphere, making practically an open waste line of it.

To connect up a heating system to return the condensation to a high-pressure boiler, it is desirable to use two "return" traps, while to return the water to an open feed-water heater or tank at a high level one return trap will be sufficient. If the water heater or tank is at a lower level, an ordinary "dump" or "separating" trap will answer. A trap will discharge water above its own level approximately two feet for every pound of steam pressure applied above the water in the trap to operate or empty it.

Having gotten the water into a return trap set higher than the water line in the boiler, it can readily be discharged into the boiler when steam at boiler pressure is admitted to the trap assisted by the hydraulic head. It is only necessary to make the vertical distance sufficient to produce the head necessary to overcome the pipe friction for the water to flow into the boiler.

On the vacuum steam system the vacuum pump usually discharges into the air-separating tank or open heater and the water is then pumped to any point desired.



# Talks on DIESEL Engines

by L. H. Morrison

*XVII—Egan confines his remarks to cooling-water systems, describing various methods of cooling, forms of cooling towers, and troubles caused by scale.*

"WE ARE going to take up cooling systems tonight," Egan announced, "and so we'll have three to consider. The first is the closed-circuit pump-feed system, like I've outlined in Fig. 1."

"That's the way we piped up our hot-ball engine," Woods declared.

"No doubt," assented the chief. "It's good for small powers only. The water is stored in the basin *A*, from which it's drawn by the pump *B*, driven by the engine, and forced through the engine jackets and heads. It is then discharged over the cooling tower *C* and drops into the basin *A*."

"Why won't it do for big engines?" one of the men asked.

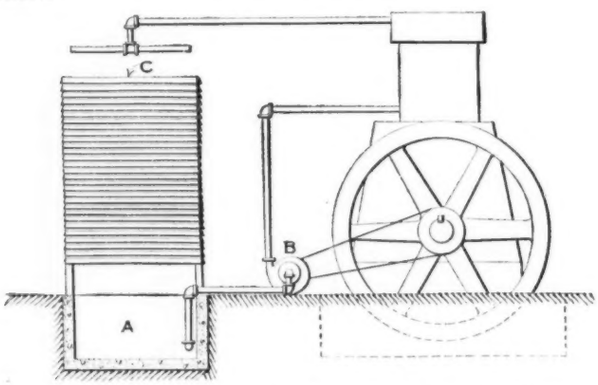



FIG. 1. CLOSED-CIRCUIT SYSTEM OF COOLING

"If I were to tell the truth, I'd say that it isn't suitable for any engine. It has one redeeming feature—that of simplicity. It is not necessary to install a high storage tank. The cooling tower need be but a few feet above ground; as a consequence the pressure head on the engine jackets is very low. The piping is cheaply installed and can be understood by the greenest of engineers. The one damning feature is the engine-driven circulating pump."

"Why so, chief?" Kelly asked. "If the engine runs, you're sure to get the water."

"You've said it, Kelly. If the engine runs, you'll get the cooling water. But how about the water when the engine is stopped?"

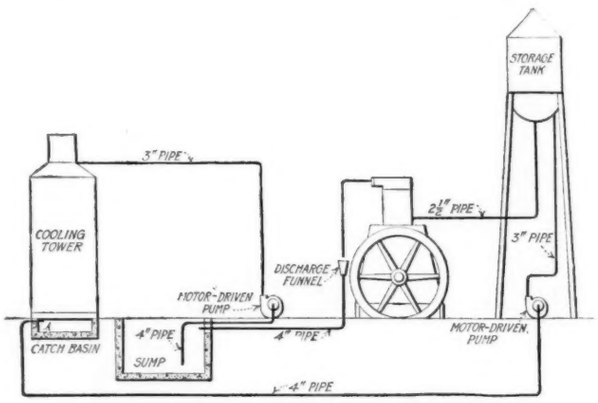



FIG. 2. DIAGRAMMATIC OUTLINE OF ENTIRE COOLING SYSTEM

"I'll bite. What's the answer? I know you've always ordered us to let the cooling water run for twenty minutes after we shut an engine down, but I always thought that was wasting water."

"Instead of being wasteful, that order really is an aid to conservation—of the engine. When the engine is running, part of the heat developed is absorbed by the cooling water, but this heat is first taken up by the piston and cylinder walls. When the engine is running properly, therefore, the jacket water is taking heat from the metal walls just as fast as they are absorbing it. Now, if you stop the engine and the flow of cooling water at the same time, there is a considerable amount of heat stored up in the piston and the cylinder walls. There is no water

**At the next meeting the men will discuss the status of the Diesel engine and the outlook for engineers trained to run this type of engine**

circulation to remove it, and the heat is conducted to adjoining parts of the engine that were not intended to withstand temperature stresses. As a result there may be warping or cracking, and seizing of the piston is another difficulty that may follow. The lack of cooling water after stopping also explains why piston-pin brasses get hot and grip the pins.

"You can see now that this system is not good for large engines. Small engines have about the same clearances as large ones, and as the expansion is less, there is less danger of seizing. But if you must use this system on an engine, be sure to use a piston or plunger pump and never a centrifugal."

"I don't agree there, J. R.," Woods began. "A centrifugal pump has the fewest parts and is nearly foolproof. It has no piston packing rings to bother with, and about all you need do is to put in a little packing around the shaft once in a while."

Egan smiled tolerantly at the younger man.

"Of course," he admitted, "if all you want is a large amount of water pumped without much attention, a centrifugal pump is O. K. But you must remember that a centrifugal pump has to be primed. Suppose your suction line began to leak air into the pump. It would lose its suction, and the flow of water would stop. If you failed to notice this at once, first thing you'd know you'd have a fractured cylinder head or a scored cylinder. But if a piston pump loses its suction by stopping of the engine, it will pick up again, since it will prime itself. Repacking plungers isn't serious, and the guarantee of positive water circulation offsets the extra work."

"How about the water pit, chief? I've heard that this plant is the only one of the company's that sports anything but a wood sump tank."

"That's because the other plants are only enlargements of old plants. They all had earth tanks, lined with 2 x 8-in. timbers, but until recently, they weren't big enough to justify a new tank as long as the earth tanks held up. When we put in the new engines, we had to install a storage tank, and so we got the concrete one. However, it is merely a sump to catch the water as it flows from the engine discharge. Our cooling tower is laid out like Fig. 3, which shows an excellent design.

"Fig. 2 will give you an idea of the layout of the entire system. A motor-driven centrifugal pump is used to lift the water from the sump to the top of the cooling tower. From the catch basin a motor-driven centrifugal pump lifts it to the 50-ft. steel tank and it then flows down through the engine. The tank holds 25,000 gal., or enough to supply all the engines for two hours in case anything goes wrong with the pumps. To beat Kelly to his question, I'd say that the centrifugal pumps are used since the storage tank and tower provide ample water for a long time even if one of the pumps should fail to work.

"The pump to the overhead tank is automatically controlled by a pressure-operated switch that causes the pump to stop when the water level is a foot from the

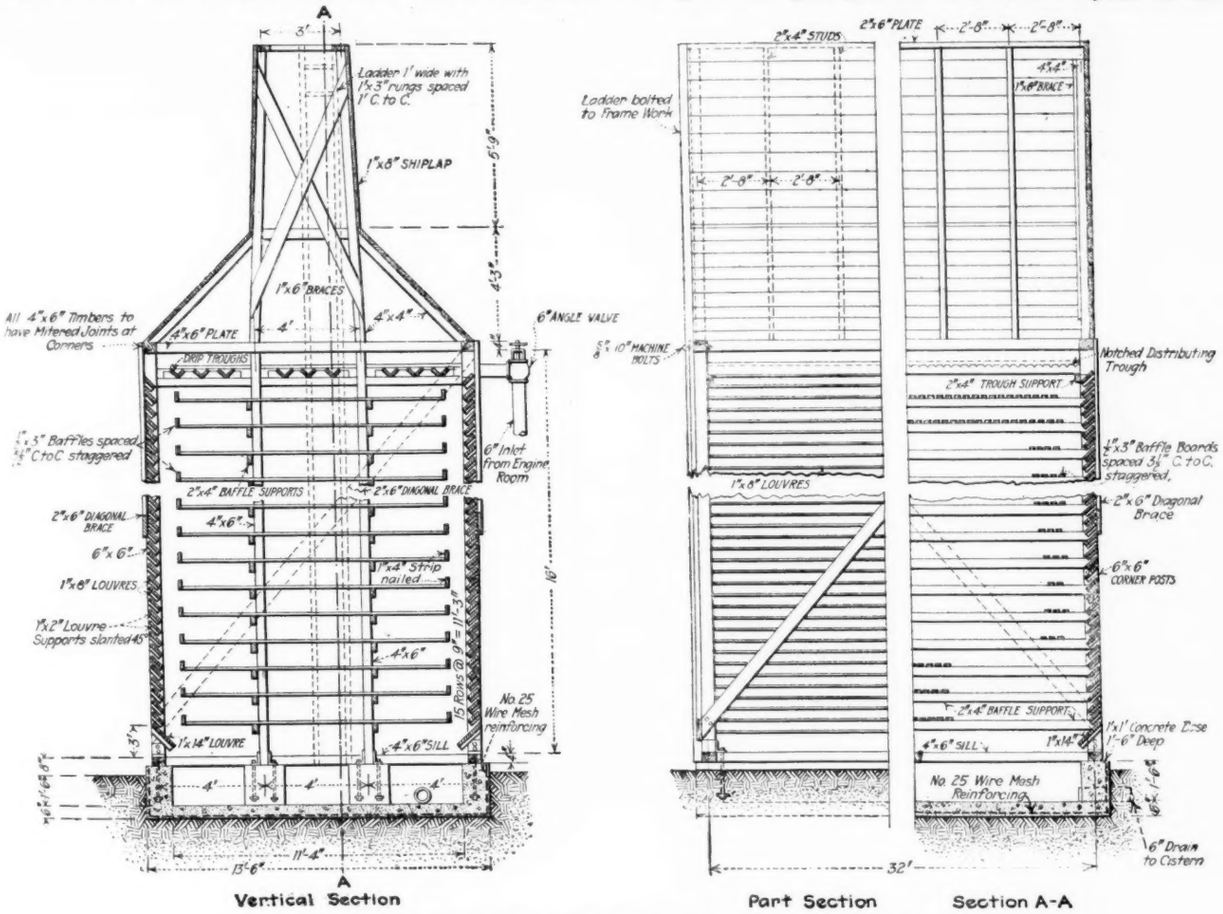



FIG. 3. DETAILS OF WOODEN COOLING TOWER OF EXCELLENT DESIGN

top of the tank and to start up again when the level is two feet from the bottom of the tank. This cuts down the amount of power used by the pump motor and prevents any overflow loss of water. As an extra precaution, I installed a bell and light alarm, as in Fig. 5.

"In the steel tank I fixed a $\frac{3}{4}$-in. iron rod *A*, over which was slipped a length of $\frac{3}{4}$-in. pipe *B* fitted with two collars and a float free to slide up and down on the pipe. A collar *C* is fixed to the end of the pipe and is held between the springs *D* and *E* that bear against the supporting bracket. Thus the pipe is held suspended, although it may be moved slightly up or down. The collar *C* carries an insulated lug *F* to which is attached one side of the electric circuit. Two insulated contact fingers *G* and *H* are fixed to the bracket and connected with the other side of the circuit through lamps of different colors. When the water gets too high, the float hits the upper collar, lifts the pipe, makes contact with the finger *G* and rings the bell and flashes the green lamps. When it gets too low, the float hits the lower collar and the lug *F* makes contact with the finger *H*, flashing the red lamps and ringing the bell. The contact fingers are made with springs to protect them from breakage in case the pump fails to start when the float strikes a collar.

"The third system is like that in Fig. 2 except that it uses a spray cooling pond in place of the cooling tower. Some plants operate this as a closed system and force the water under pressure through the jackets and out through the spray heads, which calls for a pressure of about 30 lb. However, it is my opinion that every cylinder should have a separate discharge, as should also the air compressor, the intercooler and the valve cages. The discharge lines should run into a common funnel. It is then easy to see if all the lines are open and flowing. With a closed system, one cylinder jacket could be stopped up and the single discharge at the pond would go on flowing as usual, so that there would be no indication of the trouble to warn the engineer.

"It is my opinion that the spraying system will become the standard before long. It occupies no more room than a cooling tower and pit and the water is cooled to a lower temperature than is possible with a tower. The lower temperature obtainable is undoubtedly due to the finer subdivision of the water and the more intimate contact with the air."

"J. R., what should a plant do that isn't large enough to afford the steel tank and tower?" Woods wanted to know.

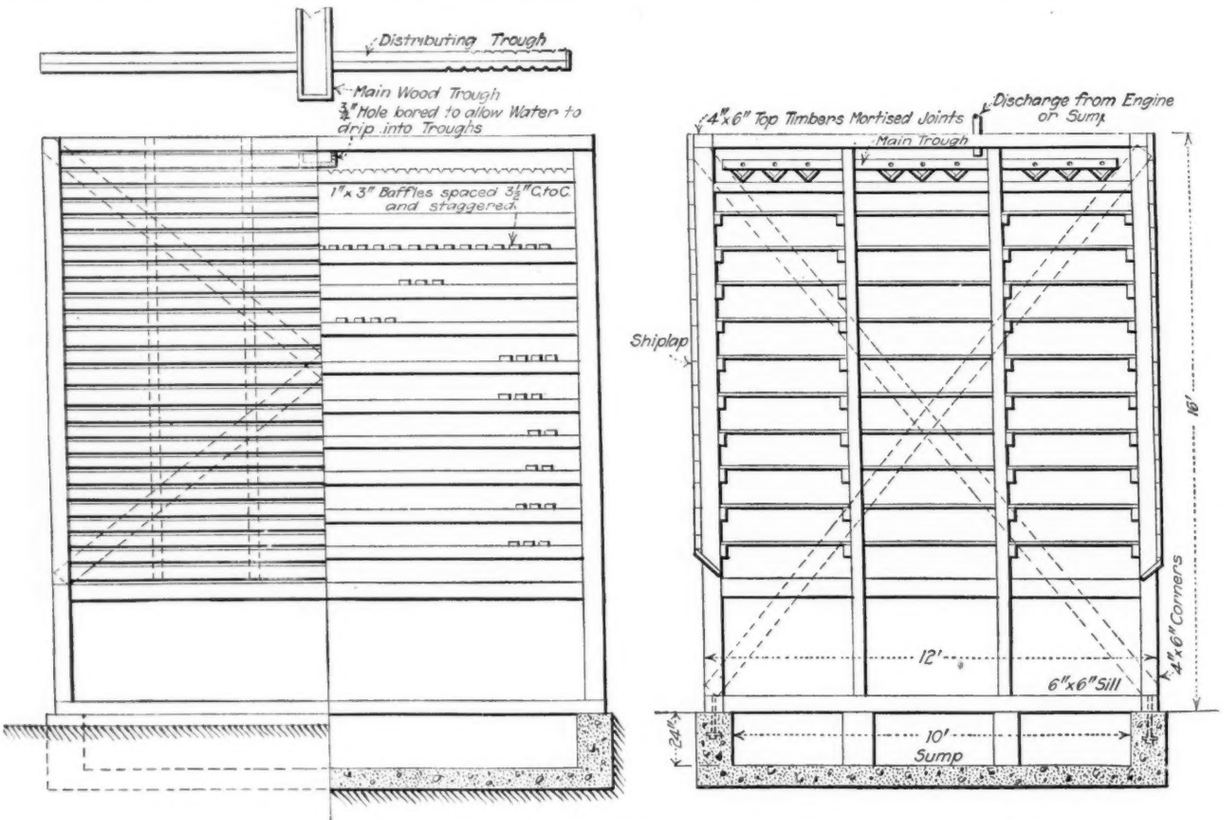



FIG. 4. INEXPENSIVE FORM OF CONSTRUCTION FOR WOODEN COOLING TOWER

"In such a case a tank 12 x 14 ft. constructed of 2-in. cypress and holding about 12,000 gal. is cheap and lasting. Such a tank should be mounted on a 30-ft. wood tower built of 10 x 10-in. oak timbers. This height will give ample pressure to the water. A cooling tower can be cheaply built along the lines of Fig. 4, which is a layout I've installed several times."

"By the way, chief, how much water ought an engine to use?"

"Well," said Egan, "let's look at that problem from a theoretical standpoint and see how it checks up with practice. The specific heat of water is one, and so for every increase of one degree of temperature a pound of water absorbs one heat unit; or, each pound will absorb as many heat units as it rises degrees in tem-

perature. The weight of water required can be found by the formula

$$W = \frac{XH}{100(t_1 - t_2)}$$

in which

$W$ = Weight of water required per horsepower-hour;
$X$ = Percentage of heat absorbed by water jackets;
$H$ = Heat developed in the cylinder per horsepower-hour;
$t_1$ = Temperature of discharge water;
$t_2$ = Temperature of ingoing water.

"Ordinarily, the value of $X$ is about 35 per cent. and to develop one horsepower-hour about 9000 B.t.u. must be produced in the cylinder. The temperature of the ingoing water will be around 70 deg. F. and of the

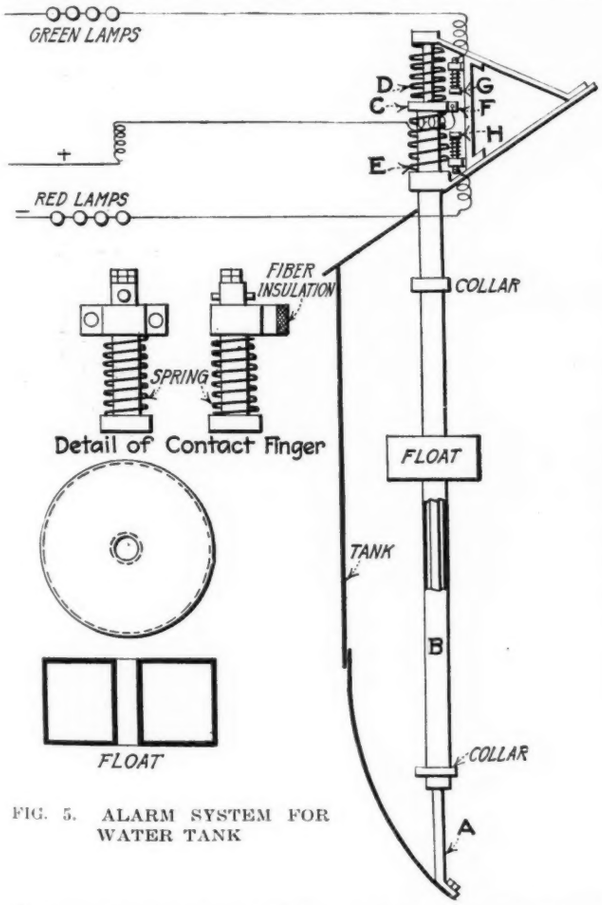



FIG. 5. ALARM SYSTEM FOR WATER TANK

discharge water about 140 deg. F. as an average. Under these conditions,

$$W = \frac{35 \times 9000}{100(140 - 70)} = 45 \text{ lb.}$$

"There's another point I wanted to mention. In starting an engine, keep the cooling-water valve closed until the engine has fired a few times. The jacket is always full of water that is a little warm anyway, so there will be no danger of cracking it. If you start the cold water through the jacket before the engine begins to fire, the chilling action will make starting pretty hard. Of course, the head will be empty, but it won't warm up at once, so there's no danger of cracking it. But this method demands some attention from the operator. He can't afford to forget to open his water valve. If it is a green bunch running a plant, it's a lot safer to start the water before turning the engine over, although this will probably necessitate starting on kerosene."

"I think you've forgotten the very thing you should have talked about," said Kelly. "I mean jacket scale."

"The joke's on me," the chief confessed. "After all the rumpus I've raised about cleaning the jackets, it's funny that I'd forget it. Some oil-engine plants are so situated as to have pure cooling water, but the majority must use whatever water is at hand, which is generally bad. Ordinarily, the hardness of the cooling water is due to sulphate of lime and bicarbonate of lime or magnesia. The sulphates don't settle out of the water unless the temperature is high. It is with the bicarbonate of lime that we must deal in the main. This will begin to deposit before the temperature reaches 200 deg. F. So it will scale the jackets under ordinary conditions. When the jacket gets scaled up, a 10 per cent. solution of muriatic acid left in two or three hours will cut the deposit so it can be flushed out."

"That seems a hard way. Isn't there a better one, chief?"

"Yes, Kelly. If a solution of soda is used in the sump tank, it will tend to settle the sulphate before it reaches the jackets. Sometimes, when the water is taken from a stream, it will deposit organic matter, but this isn't serious. It's possible to eliminate it by the use of a coagulant, such as iron alum.

"There is another trouble met wherever water is cooled and used over again. If water is passed and repassed through the engine, part of it evaporates in the cooling tower, and all the minerals that came with the original water remain in it. In time the percentage of solid matter becomes so great that part will crystallize and settle in the jackets and pipe as a sludge, which soon bakes as hard as the iron. To overcome this, replenish the entire water charge every 30 days or so. In general, all the average operator need do is to use a little soda, flush the jackets every week, and about every three months use a muriatic-acid solution if scale is in evidence."

## Air Booster for Centrifugal Pumps

Two single-stage centrifugal pumps were insufficient to keep down the water at the Algoma mine, Ironton, Minn., when the flow increased owing to the cessation of pumping at an adjoining property, says H. H. Hunner in *Engineering and Mining Journal*. One pump was driven by a 75-hp. motor at 1750 r.p.m., rated at 1290 gal. per min. against a 165-ft. head, and was pumping at approximately this head. The second pump was direct-connected to a 100-hp. motor making 1750 r.p.m., and was rated at 1500 gal. per min., with a 170-ft. head. Suction and discharge for both pumps were 6-in. diameter pipes.

Elbows on the discharge pipes were tapped for 1-in. pipe connections about five feet from the pumps, connected to an air line, and the valves were slightly opened on a 90-ft. air pressure. The added pressure increased the capacity of the pumps by 200 or 300 gal., which was sufficient to take care of the increased flow of water. The small amount of air used was not noticeable on the air line.

# The Electrical Study Course—Three-Wire Generators in Parallel

*Brings out the factors governing the parallel operation of three-wire generators and describes the method of making connections to the control panels and the details of placing a generator into service and of cutting it out of service.*

WHEN dealing with three-wire systems of large demand or having heavy peak loads at certain hours of the day, the same factors govern as in any other electrical system, and it may become necessary or advisable to install several units to supply the load instead of a single one. When such is the case, we are confronted with the problem of the parallel operation of three-wire generators, and it will therefore be well to accord the subject some consideration. Since the compound machine is the one most commonly in use, we will confine our attention to that type.

A diagrammatic representation of two such machines connected in parallel is given in Fig. 1. As explained

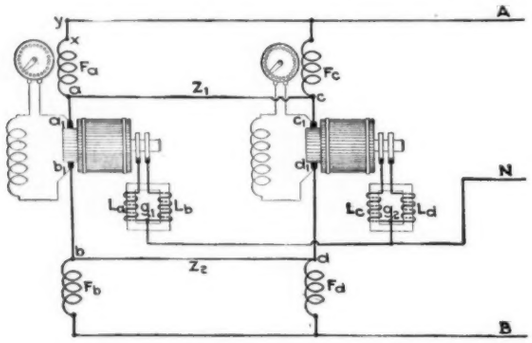



FIG. 1. SCHEMATIC DIAGRAM OF TWO THREE-WIRE GENERATORS CONNECTED IN PARALLEL

in the preceding lesson, the series-field windings of compound three-wire generators must be divided into two parts, one of which is inserted between one terminal of the armature and a main and the other between the other terminal and main, as at $F_a$, $F_b$, $F_c$ and $F_d$. Now, in the lessons dealing with compound generators in parallel it was shown that it is necessary to have an equalizing connection joining those terminals of the armatures to which the series-field windings are connected. In the case of the three-wire generator it is therefore necessary to provide two equalizing connections, since both the armature terminals in this case have series-field connections made to them. These two equalizers are shown at $Z_1$ and $Z_2$, and connect $a$ to $c$ and $b$ to $d$. The series fields $F_a$ and $F_c$ are connected between $Z_1$ and the main $A$, and the series fields $F_b$ and $F_d$ are connected between $Z_2$ and the main $B$. The mid-points $g_1$ and $g_2$ of the inductances $L_aL_b$ and $L_cL_d$ are connected to the neutral main $N$.

The two equalizers function in exactly the same manner as does the single equalizer used when two-wire compound generators are operated in multiple. Thus, $Z_1$ connects $F_a$ and $F_c$ in multiple and thereby causes whatever current flows in $A$ to split evenly between them. Likewise $Z_2$ connects $F_b$ and $F_d$ in multiple and causes the current in $B$ to divide equally between them. In order that such shall be the case, it is of course necessary that the resistance of $F_a$ shall equal that of $F_c$ and that the resistance of $F_b$ shall equal that of $F_d$, as was explained at the time that compound generators were discussed. Although only two generators are shown in the diagram, it is to be understood that any number of machines may be connected in parallel in the same manner.

The method of operating three-wire compound generators in multiple is essentially the same as that outlined for ordinary two-wire machines. The chief points of difference are that with the three-wire generator we have the inductances to connect to the alternating-current side of the machine and that we must make provision for connecting the mid-point of the inductances to the neutral main at the same time that connection is made between the direct-current side of the machine and the outside mains.

It is also necessary to provide two ammeters for each machine since the current in the two outside mains is not the same when there is current flowing through the neutral. It is also desirable to have a third ammeter to measure the current in the neutral. If one is installed, it should be of the type that has its zero point at the middle of the scale and reads in both directions from the center, since the direction of the current in the neutral may be in either direction, depending upon what side of the system is the more heavily or lightly loaded. The ammeters that are used to measure the currents in the outside mains should be connected between the series field and the armature. Thus, in Fig. 1 the ammeter should be connected between $a$ and $a_1$, $b$ and $b_1$, etc. They will then measure the current actually delivered by the armature.

If the ammeter were to be connected between the series fields and the mains, as for example, between $x$ and $y$, the current measured would be that through the series field. Since the currents through all the fields between $A$ and $Z_1$ or between $B$ and $Z_2$ are the same, the reading of the ammeter would be no indication of the load carried by the machine. This condition also introduces a complication when interpoles are used on compound generators. Since the current through the interpole windings must change with the armature current in order to secure good commutation, it follows that the interpole windings must be connected into the same part of the circuit as are the ammeters.

In Fig. 2 is represented one type of control connections for a compound three-wire generator that is to be operated in parallel with others; also the connections between it and the generator, which is of the interpole type. In the figure, $G$ represents the generator, $F_s$ its shunt field, $F_1$ and $F_2$ the two halves of the series field, and $C_1$ and $C_2$ the two halves of the interpole field. The terminal block of the generator is shown at $Y$. The terminals on it are marked with letters that correspond to letters applied to the various terminal points of the windings, such as $e$, $f$, $h$, $k$, etc. The direct-current brushes are designated by $a$ and $b$, and the alternating-current ones by $c$ and $d$.

From the block $Y$ lines are run to the three switches $S_L$, $S$, and $S_Z$, and to the shunt-field rheostat $R$. Switch $S_L$ serves to connect the inductances $L_1$ and $L_2$ to the alternating-current terminals *cd*. Switch $S$ is for the purpose of connecting the ammeters $I_A$ and $I_B$ between the points *eh* and *fk* respectively and also to connect the middle point *g* of the inductances to the neutral main $N$ of the system. Switch $S_Z$ serves to connect the series field $F_1$ between the main $A$ and the equalizer $Z_1$, and to connect the series field $F_2$ between the main $B$ and the equalizer $Z_2$. The ammeter $I_A$ reads the current delivered to main $A$ by the generator, ammeter $I_B$ measures the current delivered to main $B$, and ammeter $I^N$ measures the current delivered to the neutral main $N$.

The voltmeter $V_A$ measures the voltage across $A$ and $N$ and the voltmeter $V_B$ that across $N$ and $B$. The voltmeter $V_Z$, measures the voltage across $Z_1$ and $Z_2$, which is practically the same as that across $A$ and $B$; it is slightly higher owing to the voltage drop across the series fields connected between $A$ and $Z_1$, and $B$ and $Z_2$. Voltmeter $V_G$ is connected to the voltmeter plug switch $S_V$ to determine the voltage across the armature terminals *ef* of the generator. Circuit-breakers *DD* are installed in the armature circuit to protect the generator against overload.

At $S_X$ is represented a voltmeter switch supposed to be situated on another panel; it is shown to illustrate the method of connecting such switches in parallel, so that by the use of one plug for all a single voltmeter can be used for testing the voltages of all the machines on the system one at a time. Dotted lines are used to represent voltmeter connections to make them readily distinguishable from the other circuits.

In order to facilitate tracing out the relative positions and connections of the instruments, etc., a simplified connection diagram is given in Fig. 3. In order to make more clear, in the discussion that follows, the reason for connecting voltmeter $V$ across $Z_1Z_2$, it is shown connected across the points *qr*; since these points connect to $Z_1$ and $Z_2$, the effect on the voltmeter is the same.

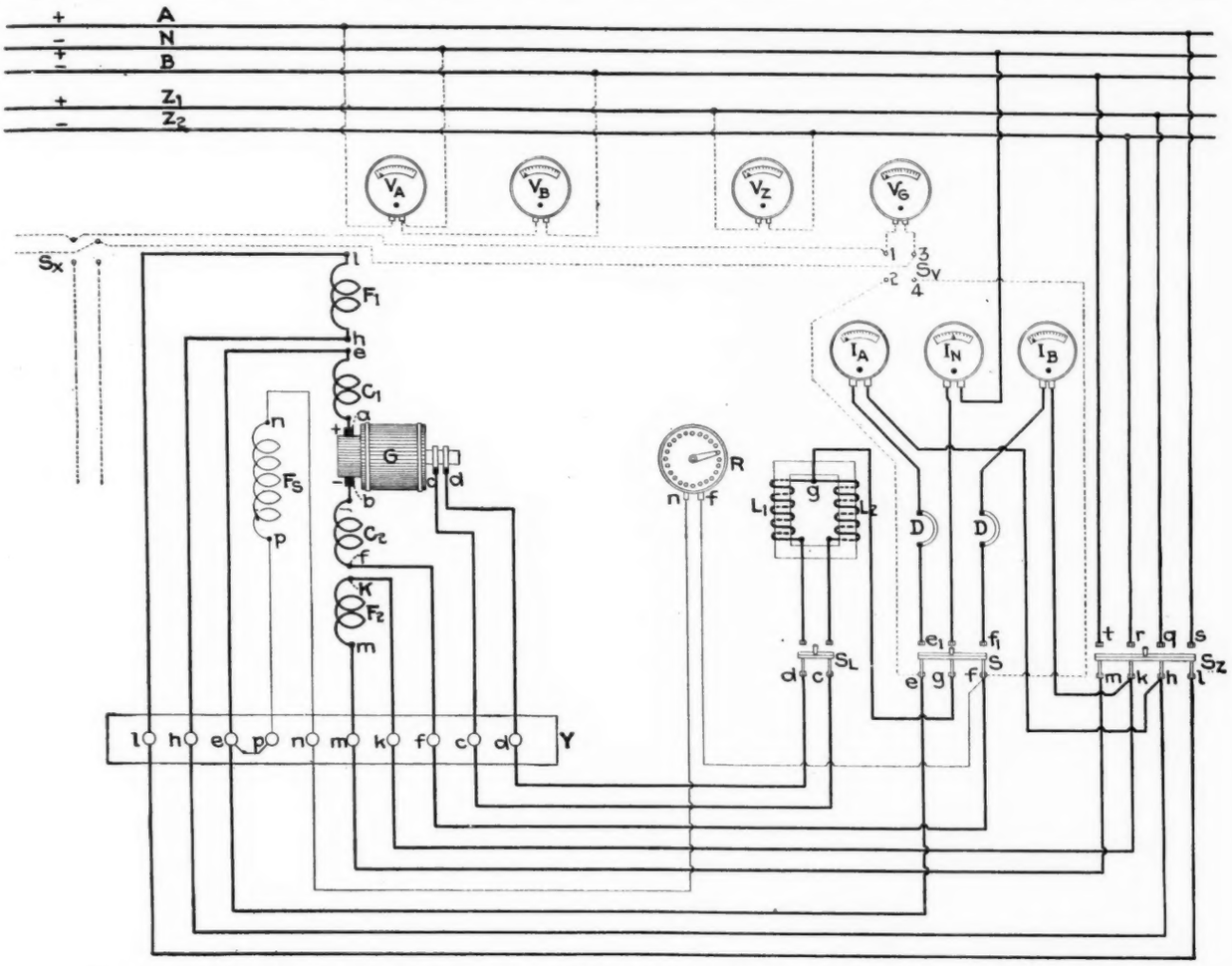



FIG. 2. CONNECTION DIAGRAM OF A THREE-WIRE GENERATOR IN PARALLEL WITH OTHER MACHINES

In order to place a generator such as that under discussion into service in parallel with other machines on the system, the following would be the method of procedure: At the time of starting all the switches would of course be open. The first step would be to start the machine and bring it up to normal speed. The plug would then be inserted into the switch $S_V$, thereby connecting 1 to 2 and 3 to 4, which connects $V_G$ across *ef*; that is, across the armature terminals of the generator. Switch $S_Z$ is now closed, causing current to flow through $F_1$ and $F_2$ and thereby giving a certain amount of series-field excitation. Thereupon the shunt-field rheostat $R$ is adjusted until the voltmeters $V_G$ and $V_Z$ read alike.

By tracing back through switch $S_Z$ it will be found that voltmeter $V_Z$ connects across $e_1f_1$. On the other hand, $V_G$ connects across $ef$. Hence it would be safe to close switch $S$ when the two voltmeters read alike. If $V_Z$ were connected across $AB$ instead of $Z_1Z_2$, it would be equivalent to having it across $st$, and it would measure the voltage across $e_1f_1$ minus the voltage drop through $F_1$ and $F_2$; and if the reading of $V_G$ were to be made equal to it, the voltage across $ef$ would be less than that across $e_1f_1$, in which case the machine

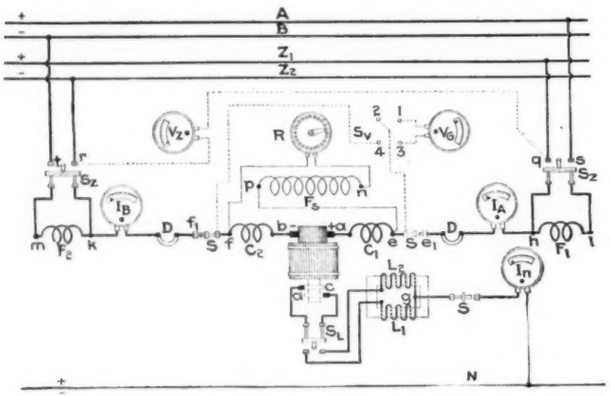



FIG. 3. SCHEMATIC DIAGRAM OF FIG. 2

would take current from the system if switch $S$ were to be closed.

Having adjusted the voltage as described, the switch $S_L$ is closed, causing alternating current to flow through $L_1$ and $L_2$. The current taken by the inductances is so small that it should have no effect on the voltage of the generator. The next step is to close switch $S$, thereby connecting the generator to the bus. If the voltage has been carefully adjusted, the generator should neither deliver nor take any current. To make it assume its proper share of the load, resistance is cut out of the field rheostat $R$, thus increasing the excitation, until the ammeters indicate that it is delivering as much current as the other machines.

To take the machine out of service, the foregoing operations are performed in the reverse order. That is, the field resistance is increased until the excitation has been reduced to the point where the ammeters show no readings. Switch $S$ is then opened, followed by switch $S_L$ and switch $S_Z$, after which the set is shut down.

The control panel for each generator has upon it all the apparatus shown in Fig. 2, except the four voltmeters $V_A$, $V_B$, $V_Z$ and $V_G$. These are common to all the panels and are usually mounted on swinging brackets at the end of the switchboard so that their indications may be read from any part of the board.

The problem of the preceding lesson was intended to show that a voltmeter will give readings of a high degree of accuracy when used to measure voltage drops across resistances whose resistance is small as compared with that of the voltmeter itself. Two resistances $R_1$ and $R_2$ of 7 and 15 ohms resistance respectively were connected in series across a source of 110 volts as in Fig. 4. It was required first, to compute the voltage existing across each resistance, and secondly, to determine what the readings of a voltmeter whose resistance is 14,372 ohms would be if connected across $R_1$ and if connected across $R_2$. The voltage across each would be the current through it multiplied by its resistance. Thus, if $I$ is the current (which is the same in both since they are in series), $E_1$ the voltage across $R_1$ and $E_2$ that across $R_2$, we have, $E_1 = IR_1$ and $E_2 = IR_2$. To find $I$ we must divide the sum of $R_1$ and $R_2$ into the voltage across them, or, $I = \frac{110}{R_1 + R_2} = \frac{110}{7 + 15} = 5$ amperes. Substituting in the expressions for the voltages gives us, $E_1 = IR_1 = 5 \times 7 = 35$ volts, and $E_2 = IR_2 = 5 \times 15 = 75$ volts. Our computation is seen to be correct since the sum of $E_1$ and $E_2$ proves to be equal to the applied voltage; namely, $E_1 + E_2 = 35 + 75 = 110$ volts.

When the voltmeter is connected across $R_1$ the conditions are those of Fig. 5. That is, we have a resistance of 14,372 ohms in multiple with one of 7 ohms, the two in multiple being connected in series with 15 ohms across 110 volts. The voltage across $ac$ will then be equal to the product of the combined current in $R_1$ and $R_V$ and their parallel resistance. If $R_p$ be used to represent this resistance, we have, $R_p = \frac{1}{\frac{1}{R_1} + \frac{1}{R_V}} = \frac{1}{\frac{1}{7} + \frac{1}{14{,}372}} = 6.9966$ ohms. The combined current through $R_1$ and $R_V$ will be $R_p$ plus $R_2$ divided into the voltage of the circuit, or, $I = \frac{110}{R_p + R_2} = \frac{110}{6.9966 + 15} = 5.0008$ amperes. Since the voltage across $ac$ is $E_1$, $= IR_p$, we have $E_1 = 5.0008 \times 6.9966 = 34.9886$ volts.

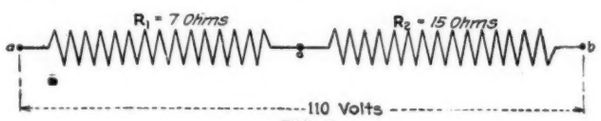



FIG. 4

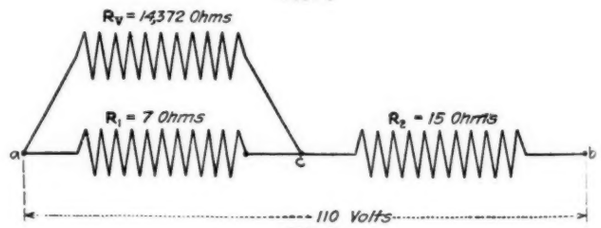



FIG. 5

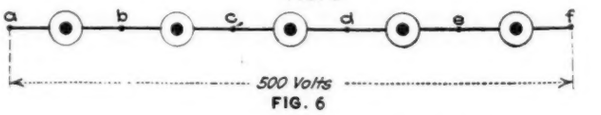



FIG. 6

FIGS. 4 TO 6. RESISTANCE CONNECTIONS

Applying the same method to the case in which the voltmeter is connected across $R_2$, we have, $R_p = \frac{1}{\frac{1}{R_2} + \frac{1}{R_V}} = \frac{1}{\frac{1}{15} + \frac{1}{14372}} = 14.9844$ ohms, and $I = \frac{110}{R_p + R_1} = \frac{110}{14.9844 + 7} = 5.0035$ amperes, from which $E_2 = IR_p = 5.0035 \times 14.9844 = 74.9744$ volts.

The discrepancy between the actual voltage existing and that indicated by the voltmeter is, in the first case, $35 - 34.9844 = 0.0156$ volt, and in the second $75 - 74.9744 = 0.0256$ volt. The degree of error in the first

case would therefore be $\frac{0.0156}{35} = 0.000617$, and in the second $\frac{0.0256}{75} = 0.000341$. To express in percentages we would multiply by 100, which would give in one case an error of 0.0617 per cent., and in the other 0.0341. Inasmuch as few instruments are guaranteed for an accuracy exceeding 0.1 per cent. and many for an accuracy of only 0.5 per cent., it is apparent that the errors due to introducing the voltmeter in the foregoing case is insignificant and may be ignored.

Five 50-watt lamps are connected in series across 500 volts, as they would be in a street car for instance. This condition is shown in Fig. 6. A voltmeter whose resistance is 50,000 ohms is used to test the voltages across the lamps. What discrepancy would exist between its reading and the true voltage when connected across *ab* and when connected across *ad?*

## Short Courses for Engineering Graduates

By J. O. Kammerman*

Those who have followed the engineering profession for the last ten or fifteen years will remember that only a short time ago men graduated from four-year courses in engineering were offered apprenticeship courses by the large manufacturing establishments. Also it should be recalled to mind that the pay offered to apprentice engineers was from seventeen to twenty cents an hour. When the wage of the apprentice engineer was compared with that of a common laborer, in most instances the laborer was getting the better pay.

When a comparison of work was made, the physical labor the apprentice was called upon to do was about as much as the common laborer did; but the work done by the apprentice called for a certain amount of skill and some technical knowledge, which was not required of the laborer. It is true, the apprentice was learning something, while the laborer was methodically moving like a mechanical device.

The apprentice continued to work for a more or less definite length of time in one department and was then shifted to another, where he again began to absorb knowledge and at the same time do a considerable amount of physical labor. By this method he finally obtained a working knowledge of the routine in each department of the factory. The time required was from two to three years.

During this period small increases in pay were effective, but the apprentice usually found his financial resources no larger at the end of his course than when he started. He has been limited in entertainments on account of his lack of funds and often has had to call upon home folks to help him meet financial obligations. To the young man who has left college with the idea of getting a start in this world and creating a fund to start his own home, the aspect at the end of his apprenticeship is not very bright. In fact, the only redeeming feature is that he can say he is no longer on the apprenticeship course. He is given a "white-shirt job" in the front office, where his chief responsibility is checking some calculations or plotting curves. After a year of this, so little real engineering has been done by the average man that he wonders why he ever spent four years in a university, and he feels that he could have saved that time by starting in the apprenticeship course without his college education.

It has been said that for some time after an apprentice starts his course he is an expense to the company. The company needs engineers, and in order to train them it goes to some expense to obtain men for its apprentice courses and willingly pays a wage that is more than they earn. This is kept up till the man is trained and the longer he is on the course the more valuable he is to the company. Evidently the company must pay a scale of wages that will return to it by the end of the training course the money lost during the first period of training. As the period during which the company pays less than the apprentice is worth comes at the end of the course, the apprentice has forgotten the earlier period of his training and feels dissatisfied with his salary, which is a condition beneficial neither to the apprentice nor to the company.

It is the writer's firm belief that the average number of men who have taken apprenticeship courses and have reached a salary of $4000 a year due to their engineering ability is far less than the average number of men who started out from college to be engineers in as short a time as possible, and not by a more or less routine method, and who are receiving $4000 or more per year.

During the period of the active hostilities between the United States and Germany and the period previous when the world war was being fought, engineers were in great demand. Salaries were abnormally high. Men were secured for engineering positions at any price. Many young men, leaving college, were paid salaries ranging from $100 to $150 per month. It is interesting to note that these men, feeling their responsibility, developed characteristics of initiative, resourcefulness, leadership and self-confidence that no apprenticeship course could give. These characteristics are required of the engineer of today, and any course of procedure that does not tend to develop them is not developing engineers. If during the stress of a war period these men can successfully fill responsible positions requiring engineering training, why is it necessary in times of peace to require a prolonged period of training?

### Men Rapidly Trained During Period of Great Demand

Employers have said that they must train their own men; yet these same employers took untrained men and in a very short time had then trained for responsible positions. Few, if any, teachers of engineering will say that graduates are experienced engineers. But if during a period of great demand a man can in a few weeks rise to a position requiring ability, why is it necessary during peace times to keep a man on a laboring job until some accident happens and he gets a real position either with the company whose apprenticeship course he took or with some competitor?

These questions are being raised and the men who complete engineering courses this spring are going to question seriously the advisability of a long apprenticeship course. The war has taught many lessons. The intensive vocational courses demonstrated what could be accomplished in a short interval. Men were trained in a very brief time to do certain tasks requiring some skill and special knowledge.

One claim made in support of a long apprenticeship course is that many college graduates do not know what

*Associate professor, School of Electrical Engineering, University of Oklahoma.

branch of engineering they wish to pursue and that the training course affords an opportunity to make an effective choice. This may be true, but too many men are so discouraged with engineering in general at the end of two years of manual labor that they cannot make an effective choice.

The writer wishes to advocate several short intensive courses, each course to lead to a definite branch of engineering. The student apprentice should make his choice when he is starting his career. At the end of the short course a position carrying some responsibility should be given to the student engineer. His pay should be commensurate with his training and ability and not a starvation wage. If the course is properly handled, those in authority will know the man's value at the end of six months as well as at the end of two years, and if he is unfitted for the work he has chosen he should be told at once and not allowed to work two years and then find he is on the wrong track.

Coöperation between college faculties and those in charge of courses for student engineers will be helpful. College courses must be changed to include more engineering work and these changes can be made so that the student of engineering will receive in college that which is now part of a student apprenticeship course.

With the college faculties weeding out the men unfit for engineers and the larger companies eliminating the undesirable men at the end of six months of training, the engineering profession would be greatly helped. The standard would be materially raised.

## Cat's Six Thousand-Volt Ground Creates No Disturbance on the System

BY FRANK GILLOOLY

The top of an oil switch as the nesting place for her brood proved a tragic choice to a cat trespassing in a 6000-volt substation. Indiscretions with high voltage frequently have been made by various animals from

THE CAT TOUCHED THE "C" PHASE LUG

rats to squirrels, invariably with disastrous results to the apparatus and the service.

In a substation where the switch gear is located in the basement and controlled from the main floor the operator was making frequent visits to the basement during the night, to make tests on a cable that had failed the day before. Investigating a burning odor on one of his trips, he found a cat's paw on the floor and the feline herself stretched rigid on top of the bus structure near some bare 6000-volt contacts. The two-phase 6000-volt 60-cycle bus is housed in a closed concrete structure about four feet high. Above it, on vertical marble panels, are the disconnect blocks; and near the ceiling, the oil switches.

The cat had traveled the length of the room to its darkest part, mounted the bus structure, and standing

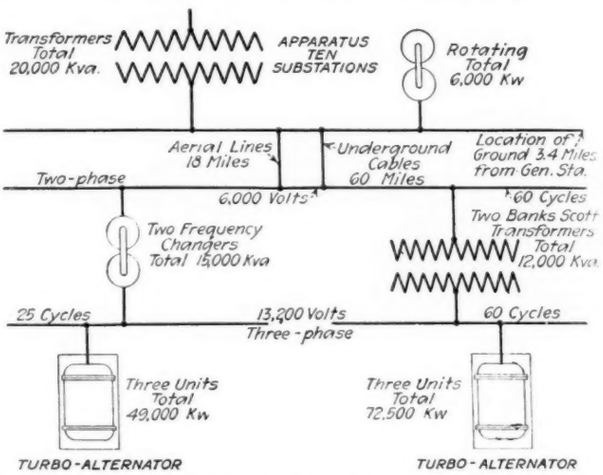



DIAGRAM OF SYSTEM WHEN TROUBLE OCCURRED

on an angle iron, touched the "C" phase lug of one of the disconnecting switches, apparently intending to leap from the top of the panel to the oil switch, which looked warm and cozy and out of sight near the ceiling. The copper lug and the iron were slightly blistered. The cat's front paws were burnt off close to the body, and her body was singed from the flame.

The interesting feature is that no disturbance was caused on the system, which had units aggregating 121,500 kw. on the line in its several generating stations, all interconnected through transformers and frequency changers, as shown. All substations are equipped with electrolytic arresters, most of them within sight or hearing of the operator, yet no arrester spill was noticed, nor was any mark made on the voltmeter charts. Three factors, probably, were responsible for there being no disturbance on the system:

1. The high resistance of the ground circuit through the cat's body, and the fact that this circuit was quickly broken when her upright position caused her body to be hurled clear of the contacts.

2. That there was no 6000-volt generator on the line. The accident occurred at 5:00 a.m. when this system, carrying 14,000 kv.-a. load, was being fed through two frequency changers of 15,000 kv.-a. total capacity, and two banks of Scott transformers of 6000 kv.-a. each.

3. That the system had been combed of leakage grounds when, at the same hour on the preceding morning, one cable had failed, its relays failed to function, and it had caused three other cables to fail and both the frequency-changer and the transformer switches to trip and kill the whole 6000-volt system.

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Carbonization of lignite, which is absolutely essential to its more general use, is strictly in accordance with modern scientific research. We are simply, from necessity, starting to do with lignite now what will eventually be done with all of our high-volatile coals.

## Dravo Superheater

In the more advanced countries of Europe no power plant is operated today, if it is of any considerable size, without superheated steam. In this country it is common to find large plants using saturated steam, although this condition is rapidly changing with regard to the more up-to-date plants, where superheated steam is used in connection with the turbine installation.

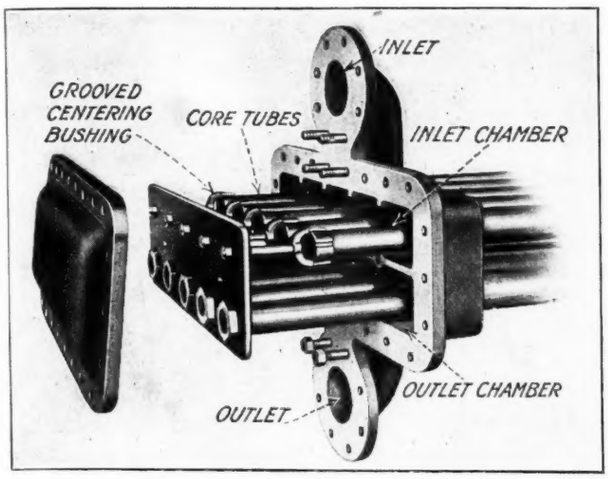



FIG. 1. SHOWING CONSTRUCTION OF SUPERHEATER

The Dravo superheater, manufactured by the Superheater and Engineering Co., 233 Broadway, New York City, is so built that the steam is agitated as it passes through the apparatus and is thereby brought into direct contact with the hot surface of the tube, which tends to produce a uniform degree of superheat at the outlet. The superheater is designed to conform to the code covering such apparatus, as adopted by the American Society of Mechanical Engineers. Details of its construction are shown in Figs. 1 and 2.

The steam enters either at the side or at the end of the header, as may be convenient, passes into the inlet chamber, thence into the annular space between the tube and core pipe of the ingoing element, both by way of the grooves and the bushings and through the core pipes themselves, passing through the connecting pieces, or return bends, into the outgoing element of the apparatus, then into the annular space in them in very much the same manner as in the ingoing element. The superheated steam then passes through the outlet chamber to the side of the header, which is connected to the steam main.

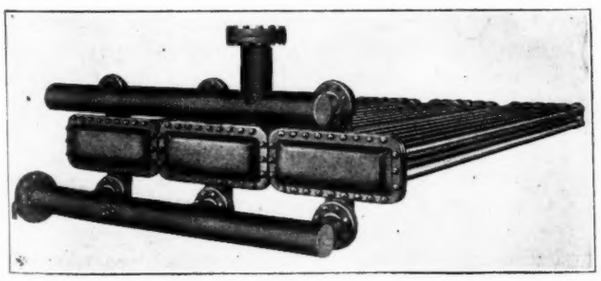


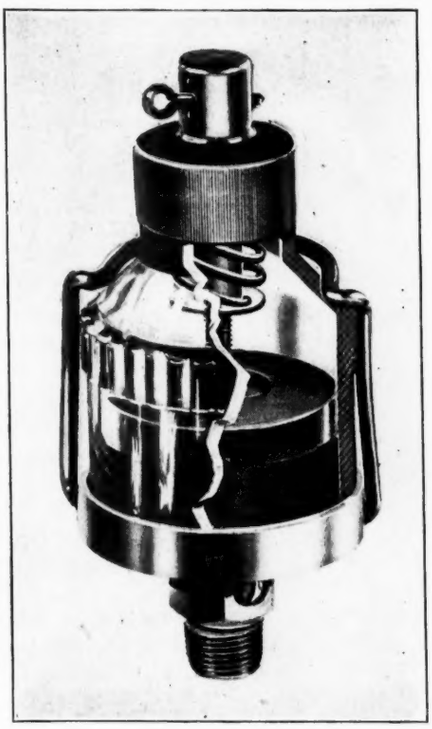
FIG. 2. ASSEMBLED SUPERHEATER

The headers are made of steel castings, and the tubes, of seamless drawn steel, are rolled into the headers the same as is done in boiler construction. The core pipes, which are contained within the tube, can be built in sections where it is desirable to remove them in restricted space, the sections being connected by joints made of steel tubing.

This superheater can be installed in various types of water-tube boilers and can also be used with return-tubular boilers.

## New Standard Grease Cup

A grease cup known as the New Standard is made by the New Standard **Manufacturing Co.,** 1325 Arch Street, Philadelphia, Penn. The body of the cup is of glass and the base is of brass. In the shank is a screw for regulating the feed of the grease. A cap fits over the top of the glass body and is held in position by a double-lock bail, as shown in the illustration. In the top of the cap are three holes in which a cotter pin fits which also passes through a hole in the end of a spring spindle. This spindle is tapped for the threaded stem of the plunger, which forces the grease out through the bottom of the cup. The three holes in the cap permit of obtaining three tensions on the spring which exerts force against the plunger.

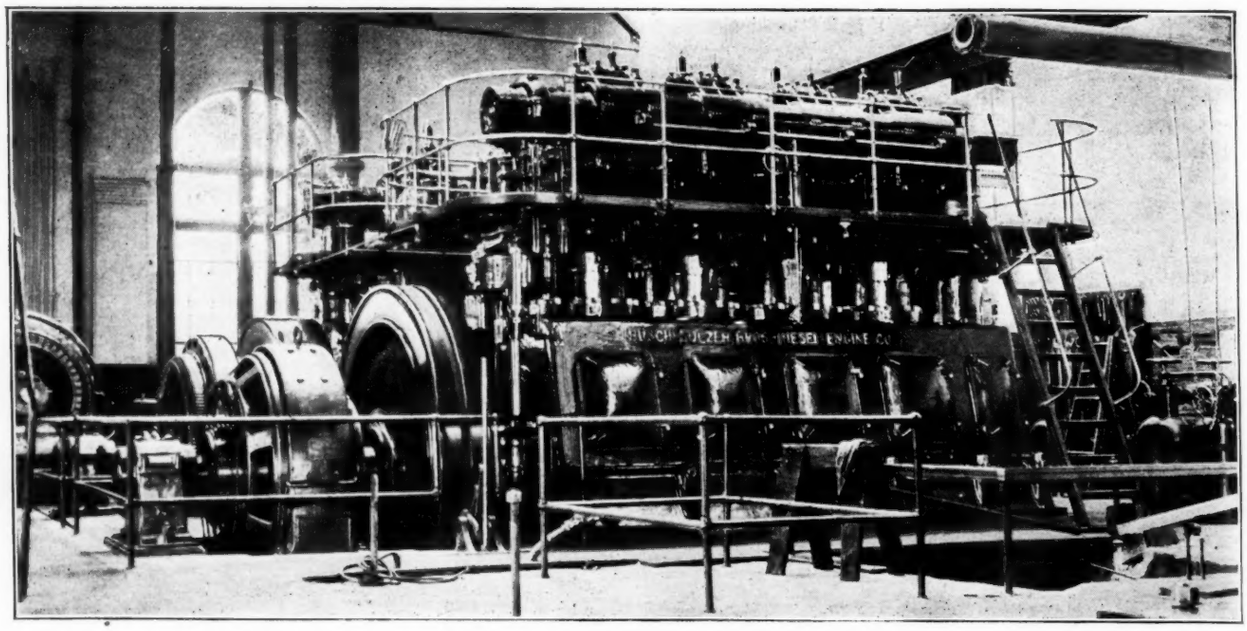


DETAIL OF STANDARD GREASE CUP

At the top of the glass body is a projection made to represent the color of grease, which is exposed to view when the grease in the cup is under the tension of the spring. As the grease feeds out, this signal gradually disappears as the cap covers it, and when it is no longer visible it indicates that it is necessary to readjust the tension of the spring for another period of feeding. This is done by turning the adjusting cap in a clockwise direction.

The feeding of the grease is regulated by adjusting the cotter pin and also by reducing the grease discharged through the bottom of the glass by means of the regulating screw. With these adjustments the pressure against the grease remains uniform from start to finish and overcomes any difficulty due to a difference in the tensional spring between the beginning and finishing of the feeding period.

To fill the cup, the body is removed after unclamping the double-lock bail, and it is easily replaced when filled. The capacity of the cup is 3 oz., it is made with a ⅜-in. shank and weighs 11 ounces.



# Diesel Engines Prove Economical

*Three 350-kw. Diesel units have been in service in this plant for more than two years in combination with steam equipment. Although maintenance cost is high a considerable saving has been realized during the war period.*

THE following results were obtained in the plant of a traction company in the Middle West operating about 70 miles of electric railway lines together with an extensive lighting, power and steam-heating business, and serving a city of more than 60,000 population, with various suburbs in addition.

In addition to the local lighting business the company supplies lighting service to from 10,000 to 12,000 suburbanites, the farthest point reached being about 6 miles from the power plant. In every suburban community the energy is sold to the municipality, which resells it to the consumer. The lighting and power peak falls between 7:30 and 9 p.m. in the summer, and 6 and 8 p.m. in the winter.

The company operates about two miles of steam heating mains, a 16-in. main from the station reaching practically all of the downtown retail district and serving theaters, churches, department stores, etc. Practically all of the steam is low-pressure exhaust from the Corliss engines. Steam from the bleeder-type turbine and live steam are seldom needed. Typical load curves for the years 1917, 1918 and 1919 are herewith reproduced. The operating power-station equipment in 1915 included one 750-kw. Curtis turbine, one 500-kw. Allis-Chalmers Corliss engine, one 325-kw. Murray Corliss engine, one 1500-kw. Curtis turbine and one 500-kw. Allis-Chalmers turbine. There was also one 200-kw. high-speed Harrisburg engine not in use. The boiler-room equipment included six B. & W. 250-hp. boilers equipped with Jones underfeed stokers, two Stirling 450-hp. boilers with Jones underfeed stokers, one Stirling 150-hp. boiler equipped with blowers and two Edge Moor 500-hp. boilers equipped with Green chain grates.

In 1916 the lighting demand increased considerably and the demand for steam heat increased more than 20 per cent. The boiler room had reached the limit of its output and it became necessary either to increase its capacity or to obtain energy from some other source. A study of the Diesel engine led to the conclusion that the necessary increase in plant capacity could be obtained without increasing the boiler-room capacity by adding engines of this type, with an increase in efficiency of the plant as a whole.

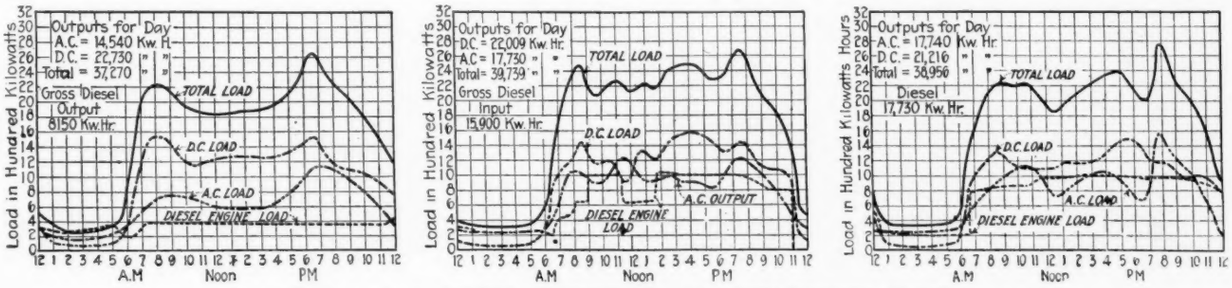
Two Busch-Sulzer four-cylinder, vertical, type-B, 500-hp., 200-r.p.m. Diesel engines were, therefore, installed in August, 1916. One is direct-connected to a 350-kw. 2300-volt. 60-cycle three-phase alternating-current generator and the other to a 350-kw. 550/575-volt direct-current generator. The guarantees for these engines provide that with a net load of from 500 b.hp. to 250 b.hp. the fuel-oil consumption will not exceed 6 gal. per 100 b.hp.-hr. to 7.4 gal. per 100 b.hp.-hr. for the two loads mentioned, respectively; the fuel oil to have a heat value of not less than 18,500 B.t.u. per pound, specific gravity at 60 deg. F. not higher than 20 deg. Baumé and not lower than 40 deg., with residue not more than 10 per cent. The speed variation from no load to full rated capacity is not to exceed 2½ per cent. from mean.

When the Diesel engines were installed, the 1500-kw. mixed-pressure turbine, using low-pressure steam from the Corliss engines and high-pressure live steam when necessary, was sold because uneconomical, and a 1500-kw. 3600-r.p.m. 2300-volt General Electric bleeder-type turbine was installed on the same foundation.

In November, 1917, one McIntosh & Seymour four-cylinder, vertical-type, 500-hp., 164-r.p.m. Diesel engine was installed. This is direct-connected to a 350-kw., 550/575-volt direct-current generator. The maker guarantees that this engine, when carrying between full and one-quarter net load will consume fuel oil of a heat value of not less than 18,500 effective B.t.u. per pound, not to exceed a range between 0.408 lb. and

0.628 lb. per brake-horsepower per hour. The speed variation is guaranteed not to exceed 3 per cent. from mean for normal variations in load, and the consumption of lubricating oil is not to exceed 2½ gal. per day.

With the installation of the McIntosh & Seymour engine the Harrisburg engine was removed, unit No. 2, of the plant. The pumps are of the vertical centrifugal type, direct-connected to motors and located in the wells close to the water level. From the supply tanks the water passes by gravity to the jacket on the engine cylinders, exhaust valves and air compressors and drains to a tank in the basement of the engine room. Thence by



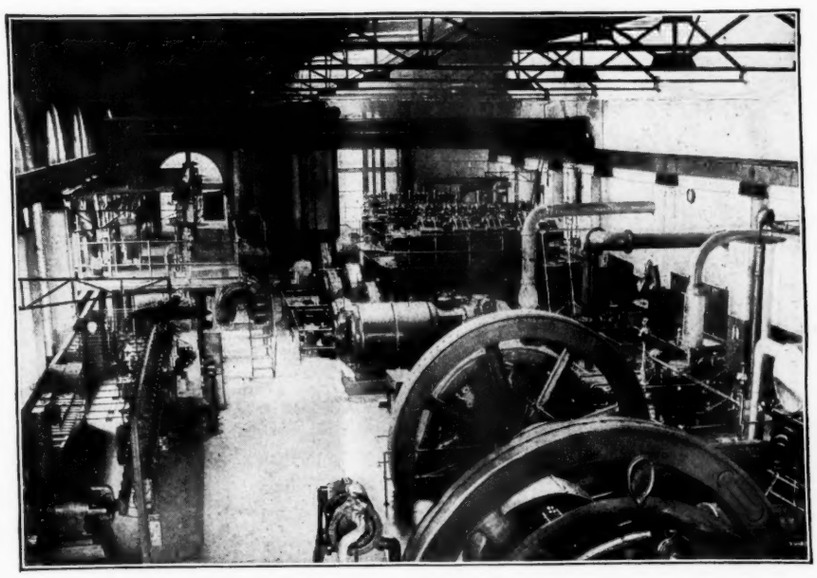

TYPICAL LOAD CURVES WITH DIESEL AND STEAM UNITS IN USE

a 500-kw. motor-generator set, was moved into line with unit No. 1 and a new 500-kw. motor-generator set was installed in line with these two. A 50-kw. motor-driven G.E. exciter set was also installed. This has sufficient capacity to serve the entire plant.

The alternating-current Diesel-engine unit operates in parallel with the 1500-kw. turbine, and after midnight during the summer season when there is no heating it carries the load. The switchboard-panel for this unit is on the alternating-current switchboard located on the balcony. The direct-current "Diesels" operate in parallel with the direct-current steam engines and motor-generator sets. Their panels are on the direct-current switchboard on the main floor. The alternating-current "Diesel" frequently carries a railway load by conversion through a motor-generator set, but it was installed as an alternating-current unit so that it could carry the lighting load after midnight.

The fuel oil is delivered in tank cars on a spur track and unloaded by gravity to two underground steel drum storage tanks with a capacity of 12,000 gal. each. From the tanks it is pumped by small motor-driven pumps, supplemented with an auxiliary hand pump for emergency use, through Worthington piston-type oil meters to auxiliary supply tanks of 30 gal. capacity and located on the wall, about 6 ft. above the fuel-oil pumps. Fuel pumps on the engines draw the oil from the auxiliary tanks and feed it, according to the position of the governor, through discharge lines to the needle valves.

Another important feature is the cooling water for the engine. This is pumped from wells just outside the plant to a 16 x 16-ft. tank located on the roof



GENERAL VIEW OF ENGINE ROOM

means of a small, horizontal, motor-driven pump, approximately 100 gal. per minute is carried back to the supply tank on the roof. This return of part of the cooling water to the original supply is a feature added some time after the installation of the engine. The temperature of the well water is from 50 to 55 deg. F. It was at first found that this was so low as to cause sweating in the air compressors owing to the fact that the air drawn in from the room is at approximately 72 deg. F. and is moist from the steam-generating equipment. Water formed in the air compressors drained out and washed out some lubricating oil. The 100 gal. of water per minute now returning from the basement at a temperature of about 110 to 125 deg. F., mixes with the cold well water and gives a resultant temperature of 70 to 80 deg., approximately the room temperature. The air intake has now been placed outside the building and all entering air passes through flannel strainers, thus eliminating all dirt and furnishing air not laden with moisture from the steam equipment.

The water from the company wells is very salty. It cannot be used for piston cooling on the Busch-Sulzer engines because when heated the water forms a scale which destroys the efficiency of the cooling operation. City water is used for this purpose and is regulated to 38 lb. pressure. The water purchased from the city also contains scale-forming materials and if raised to a temperature sufficiently high will in cooling deposit a scale which requires an occasional sulphuric-acid bath to remove. Failure to remove this scale is liable to result in cracked pistons, and failure to remove the scale

from the cooling passages in the cylinder heads will cause these to crack due to the fact that the cooling is not properly performed if the passages are filled with scale.

The accompanying table gives data on the operation of the plant for the years 1915 to 1918 inclusive.

OUTPUT AND COSTS OF OPERATION OF POWER PLANT

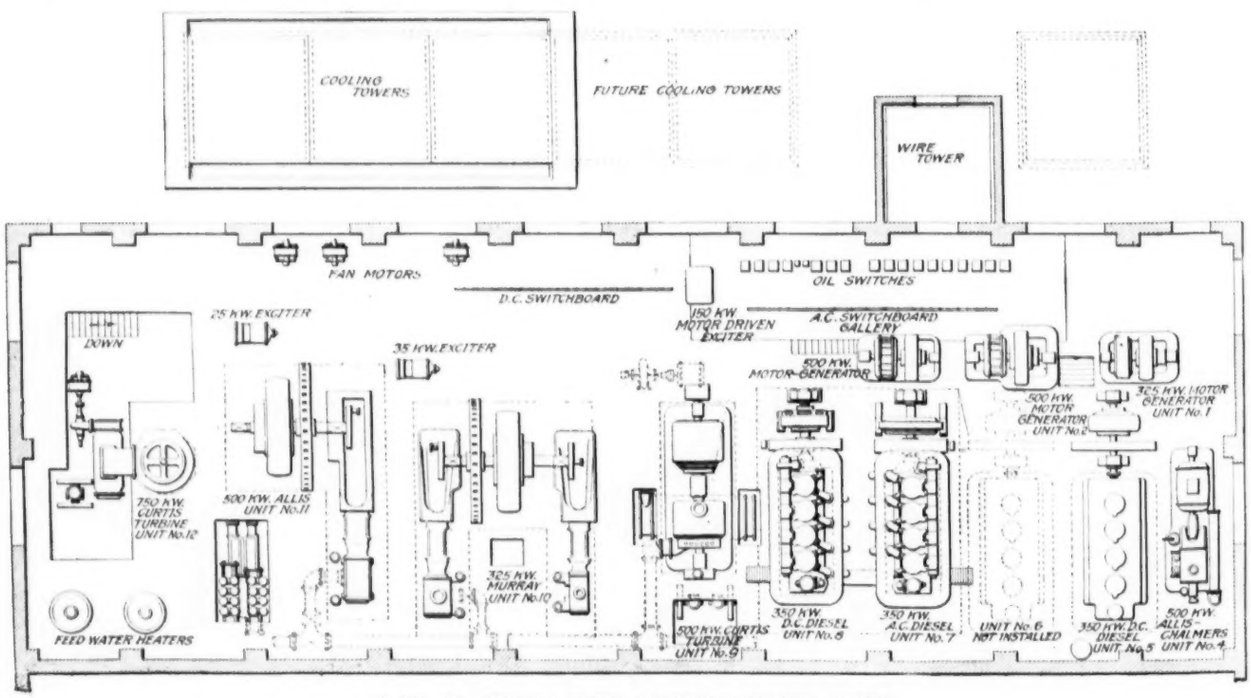
| | 1915 | 1916 | 1917 | 1918 |
|---|---|---|---|---|
| Kilowatt-hours generated | 10,776,910 | 11,531,890 | 12,613,994 | 12,907,625 |
| Kilowatt-hours used by railway | 6,161,741 | 6,194,657 | 6,180,776 | 6,076,431 |
| Kilowatt-hours used for light and power | 4,615,169 | 5,337,233 | 6,433,218 | 6,831,194 |
| Pounds of steam sold | 68,588,000 | 83,499,000 | 92,728,700 | 75,643,000 |
| Kilowatt hours generated by steam | 10,776,910 | 10,062,180 | 8,309,057 | 8,291,539 |
| Tons of coal used | 38,411.51 | 42,652.19 | 35,736.17 | 31,110.43 |
| Average cost per ton | $2.87 | $3.50 | $4.59 | $4.96 |
| Pounds of coal per kilowatt-hour | 7.13 | 8.48 | 8.60 | 7.50 |
| Cost of coal per kilowatt-hour, cents | 1.02 | 1.48 | 1.97 | 1.86 |
| Total cost of coal | $110,339.57 | $149,271.05 | $163,938.99 | $154,329.60 |
| Kilowatt-hours generated by Diesel engines | None | 1,469,710 | 4,242,377 | 4,616,086 |
| Gallons fuel oil used | None | 136,664 | 395,568 | 427,967 |
| Average cost per gallon of oil, cents | None | 3.14 | 3.70 | 5.66 |
| Kilowatt-hours generated per gallon of oil | None | 10.70 | 10.70 | 10.70 |
| Cost of oil per kilowatt-hour, cents | None | 0.292 | 0.345 | 0.566 |
| Total cost of fuel oil | None | $4,294.12 | $14,646.77 | $24,238.99 |
| Total fuel cost (oil and coal) | $110,339.57 | $153,565.17 | $178,585.76 | $178,568.59 |
| Average cost of fuel per kilowatt-hour, cents | 1.02 | 1.33 | 1.41 | 1.38 |
| Wages of power-station employees | $20,967.92 | $24,797.08 | $27,029.13 | $39,320.33 |
| Cost of water | 7,839.49 | 9,699.51 | 7,424.19 | 8,711.05 |
| Cost of lubrication | 1,127.08 | 2,404.24 | 3,851.77 | 4,991.90 |
| Cost of power purchased | 317.26 | 386.32 | 1,898.75 | |
| Miscellaneous expense | 1,902.42 | 2,134.75 | 2,761.34 | 3,548.71 |
| Power-plant maintenance cost | 13,136.66 | 11,891.43 | 20,179.56 | 25,376.53 |
| Total cost of power-station operation | 155,630.40 | 204,878.50 | 241,730.50 | 260,517.11 |
| Switchboard cost per kilowatt-hour, cents | 1.44 | 1.78 | 1.91 | 2.02 |

It will be noted that during 1917 and 1918 the Diesel engines carried more than one-third the load of the plant. Also that the cost of coal per kilowatt-hour generated in 1918 was 1.86 cents, while the cost of oil per kilowatt-hour generated was only 0.566 cent. Part of this difference is offset by the increased cost of maintenance of the Diesel engines as compared with the steam units and by the fact that the coal cost also includes that of the coal used for heating, but there is an estimated saving of at least 0.9 cent per kilowatt-hour on all energy generated by the Diesel units. As this amounted to 4,616.086 kw.-hr., the saving was more than $41,000 in one year on switchboard cost.

### Virtues and Limitations of the Diesel Engine

The Diesel engine is economical because it will burn a low grade of fuel and upon combustion of the oil, as in the gasoline engine, practically all of the mechanical energy is imparted directly to the piston. The maintenance cost, however, is high. This is still an unknown quantity in this particular plant as records are not kept which permit separating the labor and overhead costs from those of the steam equipment. Since the Busch-Sulzer engine is designed for piston cooling, the local condition of the cooling water has made the lubrication cost of this engine higher than on the other type. Recently, the Busch-Sulzer company has perfected the design of the piston-cooling equipment so that it does not interfere at all with the lubrication of the engines, and the lubrication has been reduced to as little as two gallons of oil per day per engine.

The ideal operating condition for the Diesel engine is a constant load. This is true not only because the engine operates at highest efficiency under a constant full load, but because the capital tied up in this equipment is so large that no units can afford to stand idle many hours of the day. As a Diesel engine cannot be heavily overloaded to carry a peak and as it is not economical to allow an engine to lie idle or operate on extremely light load many hours of the day, the advisable plan for a plant with a load having one or more extreme peaks is either to operate with all steam equipment or enough Diesel equipment to handle the average load and a turbine to take the peak and overload. There is perhaps some objection to a mixed installation of this sort due to the fact that an engineer who can operate steam equipment satisfactorily cannot always operate a Diesel engine equally well. Therefore a specially trained man is advisable.


COOLING TOWERS
FUTURE COOLING TOWERS
WIRE TOWER
FAN MOTORS
D.C. SWITCHBOARD
OIL SWITCHES
25 KW. EXCITER
150 KW. MOTOR DRIVEN EXCITER
A.C. SWITCHBOARD GALLERY
DOWN
35 KW. EXCITER
500 KW. MOTOR-GENERATOR
500 KW. MOTOR GENERATOR UNIT No. 2
325 KW. MOTOR GENERATOR UNIT No. 1
750 KW. CURTIS TURBINE UNIT No. 12
500 KW. ALLIS UNIT No. 11
325 KW. MURRAY UNIT No. 10
350 KW. D.C. DIESEL UNIT No. 8
350 KW. A.C. DIESEL UNIT No. 7
UNIT No. 6 NOT INSTALLED
350 KW. D.C. DIESEL UNIT No. 5
500 KW. ALLIS-CHALMERS UNIT No. 4
500 KW. CURTIS TURBINE UNIT No. 9
FEED WATER HEATERS

PLAN OF ENGINE ROOM SHOWING MIXED UNITS

# EDITORIALS

## The Meter Expert

THE trend in power-plant design and management during the last four or five years has been in the direction of the perfection and use of appliances for metering and recording the performance of the plant, as well as the service rendered by the various integral parts, such as boiler-efficiency meters, steam-flow meters, water meters, coal weighers, $CO_2$ recorders, flue-gas analysis apparatus, tachometers, calorimeters and indicators.

The checking more closely of power costs and load conditions and the constant increase in appreciation of the economic possibilities of installing meters and recorders for this purpose in many cases so greatly increases the detail work imposed upon the operating force that satisfactory service in both operating and checking costs and efficiencies cannot be obtained; and usually, the tendency of the force is to keep the plant running and to neglect the finer points involved in taking meter readings, seeing that meters and recorders are kept in continuous service, etc.

All of which leads to the desirability of providing in most plants of any magnitude a special attendant for taking care of the meters, looking after their proper operation, taking records from them, and digesting and making use of this information in such a way that it can be applied to improve the efficiency and economy of the whole plant.

The extremely delicate design embodied in many recording instruments for the purpose of insuring high accuracy, and the highly technical knowledge required in the proper checking and intelligent use of present-day refined meter apparatus also rightly take this class of apparatus beyond the scope of the average plant operator, and again point to the desirability of a special man for meter service. Every maker of recording and metering equipment will impress on the prospective purchaser the fact that in order to furnish complete satisfaction the apparatus must be given intelligent and careful attention and should be in continuous service; that the records produced should be studied and digested and conclusions reached which can be applied to bettering plant operation. The man in charge of keeping the boilers, engines, turbines, pumps and multitudinous other equipment and details going in the power plant cannot logically be expected to give this continual and special attention, even though he is perfectly sincere in his attempt to do so.

It is also appreciated by most managers that the value of a meter of any kind is practically nil if it is not kept "up to scratch" all the time. With the delicate construction involved in most equipment of this nature, this means constant inspection, cleaning, careful adjustment and checking from time to time—all work that cannot be done properly and completely by the general operating staff in conjunction with their other duties.

In the manufacturing plant of today the production force is not called upon to take care of the accounting, but this detail work is intrusted to other hands, which have the time and special training for this work. The same thing should be true of the power-manufacturing station. All the evidence seems to point to an increasing appreciation of the value of a meter expert and accountant for every good-sized station.

## The Personal Element in Arc Welding

IN THESE days, when one hears of welding ships' boilers, steam lines, pressure tanks, etc., electrically instead of riveting them, it is well to consider the element in the process upon which its success hinges; namely, the welder. Machine welding may eventually eliminate many of the factors that are contended with today and thus produce a weld of uniform excellence. Even then, much of the work will have to be intrusted to the individual, and it will be upon his experience and capability that the safety of the structure will largely depend, until such times as there may be developed a means of testing the weld without destroying it.

The training of such operators therefore appears to be a matter of vital concern to the interests involved. Certainly, the agencies that control the construction and insurance of ships, boilers, pressure tanks and the like, will insist on rigid qualifications as regards not only the process and the material employed but, more particularly, the demonstrated ability of the man who actually does the welding. And this is as it should be, for at the present time it is impossible to judge of the soundness of a weld from exterior appearances; the only person acquainted with the quality of the interior of the weld is the man who made it. Since so much may depend upon its reliability, it is essential that the operator be one who not only is capable of executing satisfactory work, but will recognize the presence of any element likely to jeopardize the success of a weld, and, moreover, one who will have the moral courage to advise his superiors of any possible flaw, be it due to his own neglect or not.

From what ranks of labor to recruit a competent force of welders is a serious question. Certainly, it would appear that the individual must be possessed of intelligence and integrity. The oxyacetylene welding industry has broken in men from many trades. Some of the most promising material has proved the most disappointing, and vice versa. To judge of a man's ability, he must be given an opportunity of developing himself, and it is consequently to the interests of the employer to provide the opportunity. As a matter of fact, it would be desirable to see the establishment of schools or shops of instruction, through the support of the industry in general, the purpose of which would be the training of certified operators to be employed on work of exacting specifications. There is much welding that does not require a high degree of skill, and it would not be necessary to insist upon the same qualifications for this secondary work as for the major operations.

The newly organized American Welding Society might well include among its contemplated activities

the creation of an educational establishment of some kind that will provide means for education along the lines suggested. To it should be attracted a large group of clever, conscientious workers, as they would be a great factor in the looked for rapid development of welding, as applied to critical structures. But when this is all done, there still remains the fact that the human element is not infallible, and until we can test the weld without destroying it, there will always remain the possibility of a weld being improperly made in a structure whose failure will cause a catastrophe. We shall probably soon advance to the stage at which the electrically welded boiler will become a reality, but who would care to live with one of them unless he knew beyond a doubt that each seam was a one hundred per cent. weld?

## Why Not Overhaul Now?

TO DATE one million troops have returned from France, and according to Secretary Baker the remainder are to return at the rate of three hundred thousand per month.

Finding employment for these men is a matter of pressing moment. Through lack of funds the Department of Labor has been unable to cope with the situation, and the War Department has found it necessary to establish agencies of its own.

Doubtless many of the men are returning to their former positions. Others have returned to find their old jobs no longer in existence. Some will be affected by the wider employment of women; while others, profiting by their experience in the Army, are aspiring to better positions than they formerly held.

Unemployment, however, does not appear general throughout the country; instead, it is localized in certain large cities and industrial centers, particularly those near ports of debarkation—a condition easily explained. Men from the rural districts naturally desire, after being demobilized, to locate in the large cities. Others without such intention linger in these cities to see the attractions, spend their money and are compelled to seek employment.

This excess of labor is but a transient condition. As soon as industry has become readjusted to peace-time conditions and started full speed ahead, of which there are promising indications, it is anticipated that there will be an actual shortage of labor, especially in view of the increasing emigration rate.

Meantime there is plenty to be done.

During the war equipment of all kinds was overworked and taxed to the limit of its material endurance. The exigencies did not permit taking out of service for overhauling, and much of it did not receive even ordinary maintenance. This condition was aggravated in some cases by inexperienced operatives.

Today we are witnessing the result; machinery everywhere is creaking, engines are pounding, furnaces need relining, joints are leaking, ferryboats are unable to maintain their schedules, roadbeds need attention, buildings are in need of repair—in short, the country physically needs overhauling to put it in condition for the stress of normal industrial conditions.

To do this requires labor. The labor is now available; in a few months it may not be. The proposition is neither one of patriotism, nor one of appreciation for the work done "over there"; it is just simple economy to put the house in order.

## The Need of Boiler Inspection

AN IMPRESSIVE demonstration for those who assume that ordinary business caution and self-interest are sufficient inducements for the owners and operators of boilers to keep them in a safe if not an efficient condition is furnished by the Annual Report of the Inspection Department of the Hartford Steam Boiler Inspection and Insurance Company. During the last year their inspectors examined 391,674 boilers, in which they found 194,849 defects sufficiently serious to be reported, or nearly one-half as many defects as there were boilers. Of these defects 21,847, or over eighteen per cent., were positively dangerous.

The inspector is ordinarily concerned with defects that impair the safety of the boiler, and in ordinary years will report about one thousand settings as defective, of which perhaps eight hundred will be reported as dangerous. During the last year the inspectors have been working in connection with the various committees of the Fuel Administration, and have striven for efficiency as well as for safety, reporting 9890 settings as defective, or nearly ten times as many as usual, while those regarded as dangerous numbered 828. The effect of the continual vigilance of a corps of inspectors of this kind upon the list of industrial accidents is well worthy of consideration.

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One of the weak points in the early types of squirrel-cage induction motors was the connection between the rotor bars and short-circuiting rings. This connection was generally made by bolting or soldering the bars to the rings. For a number of years it has been common practice for electrical manufacturers to weld the bars to the end rings or cast the rings onto the ends of the bars, and this practice has practically eliminated the trouble experienced with bolted or soldered connections. The latest practice is to cast the rotor winding on the core, the stripped rotor core serving as the mold in which the bars are cast.

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Elsewhere in this issue is an article dealing with the lubrication of submerged pins in the governor mechanism of hydraulic turbines, which will be received with much interest by hydro-electric engineers. Corrosion of these pins imposes severe strains upon the mechanism and often causes the fluid pressure to be greatly increased, perhaps dangerously increased, at a time of heavy load demands—a critical time. The monel-metal pin by trial shows itself, with direct lubrication, to be by far superior to all others.

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Oil and water do not mix, according to an old saying; but it will be difficult to impress that fact on the oil producer who has to spend considerable money in dehydrating petroleum before he can market it.

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"Emancipation of the toiler" is a phrase with a pleasing sound; but if it is interpreted as freedom from the necessity of working, it is only a thin disguise for Bolshevism.

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The man who doesn't want to be convinced of a mistake follows closely a familiar rule of cylinder design: The thicker the head, the greater the resistance.

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An untrained fireman somewhat resembles the average brick chimney. His footing is broad and stable, but he is rather thin at the top.

# Correspondence

## Meter Readings Showed Up Leak

Meters, if read daily and the readings watched, are an accurate index of plant conditions, especially if there happens to be much unexposed or underground piping; and if carried out properly, the readings are a check against undue waste and hidden leaks as applying particularly to water or gas lines.

The daily readings should be recorded and filed for reference, as they will be found useful for comparison and they offer a ready means of supplying such data as the manager may ask for at any time. I had occasion recently to realize what an important matter this is, and if I had not made daily meter readings, I do not know how long a serious leak would have remained undiscovered.

On reading the cold-water meter one morning, I found that three times the usual amount was recorded; as no leaks were reported I thought that perhaps the meter had given a false reading. But on finding a like reading the next morning, I decided that there must be a blind leak somewhere that did not show up in the usual way, and so set out to make a thorough search for it. The only evidence discovered was a small amount of vapor rising from the conductor pipe leading from the roof of one of the residence houses to the underdrainage system.

There was a 20-in. conduit carrying steam, return, hot water and circulating lines from the main building to this house, and as this conduit was drained into this same underdrain, it seemed reasonable that the leak might be in one of these pipes and followed the conduit into the underdrain and so on into the conductor to the roof. This proved to be the case, for after shutting off the hot-water line the leak stopped.

This line was 1½-in. lead-lined galvanized pipe, and to replace it not only meant digging out the line and opening the conduit for a distance of 175 ft. and replacing, but for half the distance we would have to go right through a fine flower garden and dig up shrubbery, etc., so I was asked to try some other means of renewing the line.

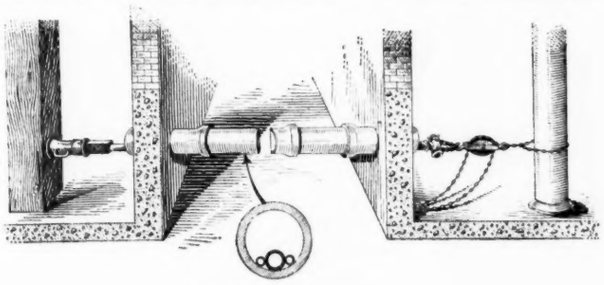
On referring to the blueprints it was found that this line ran straight with no offsets between the two buildings, and it looked as though it might be possible to pull the old line through the conduit and drag the new line through on the end of the old one. It seemed worth trying, as the only danger of trouble seemed to be in pulling the old line in two at a weak spot, but even so it would not make matters worse than they were.

After breaking the connections at both ends of the line in the basements of both buildings, a two-ton chain hoist was rigged on one end and a screw-jack was placed against the other end. The jack was used to keep sufficient pressure against the line to supplement the pull on the hoist, which might be great enough to pull the line apart. With one man on the hoist and another on the jack and both working by signal (rapping on the pipe), a start was made. The first foot came hard, but the next came easier, and after the first eight feet was through it was found that the hoist alone was sufficient to do the work.

A length of new brass pipe was then connected to the tail end and pulled in, and the length of old pipe in the other basement was disconnected and so on; connecting a new length on one end and pulling it in and disconnecting the length of old pipe on the other end, until the old line was all out and the new brass line was in and connected up. The whole job took only a little over a day to finish. This was about one-third the time necessary to just dig the trench; besides, mutilating the flower garden was avoided.

This line was covered with 85 per cent. magnesia pipe covering, and the new line was pulled through without pulling out more than a handful of this material, a little of which came through with each coupling.

The lead-lined pipe was found to be eaten through from the outside in several places, which goes to show that brass pipe only should be used to carry hot water, especially in unexposed places where not easily replaced.



ENLARGED CROSSECTION

REMOVING THE PIPE FROM THE CONDUIT

We have hundreds of feet of lead-lined pipe carrying hot water to different buildings, and our experience has been that where it is exposed, as in our open tunnels, with only magnesia covering, it has given no trouble after being installed for five years; but where it was run through a tile conduit buried in the ground, we have had to take it out and replace with brass, and in each case the lead-lined pipe was found to have been eaten through from the outside.

The second time this happened a piece of the pipe and covering and tile conduit were sent to a laboratory for analysis in order to determine what caused the eating away of the pipe, but we received no satisfactory answer. Perhaps other engineers have had similar experience, and it might be interesting to know about it.

Records such as meter readings are easily secured with but little trouble, and they should be kept on file. If they are studied, they will tell a great deal about the conditions in the plant. I had occasion lately, in connection with the Fuel Administration work, to examine many questionnaires, and it was surprising how many engineers could not answer the question as to how much electric current was purchased and how much was generated in their plants, although there were meters there which should have given them this information.

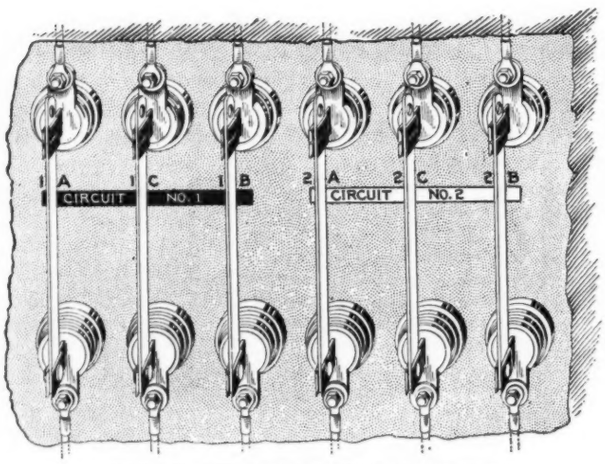
Windsor, Conn. J. A. LANE.

## Installing Disconnecting Switches

There are often several ways of doing a job. Each of these ways may be good, but only one method can be the best. The way in which D. R. Hibbs overcame the difficulty in installing disconnecting switches, as described on page 293 of *Power*, is open to criticism.

Instead of turning the disconnects of each circuit around alternately so that each circuit would be distinguishable from its neighbors, it would have been simpler and more satisfactory in the ordinary way to have identified each circuit by stenciling. Moreover, each phase of each circuit should also be stenciled.

Without the installation of barriers between the respective circuits, each circuit could be segregated from those adjoining it, so far as preventing mistakes on the part of the persons manipulating them is concerned, by merely painting on the marble mounting a line about two inches wide extending across the space covered by all three phases of one circuit. White and blue or white and red can be used alternately, or the lines of alternate circuits can be staggered so as to




MARKING DISCONNECTING SWITCHES

distinctly indicate the change from one circuit to the next. All phases should be marked, as also the circuits, because many mistakes occur when disconnects are hurriedly opened under load. A suggested form of marking that is safe and simple is shown in the figure.

As to barriers between circuits and phases, the war has taught that massive barriers so often previously employed are not needed in many cases. For potentials below 4000 volts and with a minimum spacing of 10 in. barriers can be dispensed with altogether, except perhaps the generator disconnects, where the concentration of energy may make them advisable. Barriers are installed not only to prevent short-circuits due the bridging of conductors by arcs, but to prevent confusion. The methods herein advocated eliminate the latter. There is one instance where barriers are always advisable, or else additional spacing should be allowed, and that is where intense drafts or winds may be expected to blow across the various conductors. Barriers in these cases prevent an arc being blown across phases or circuits and causing a short-circuit.

There is one further criticism that might be offered. Where disconnecting switches are installed in the horizontal position with the switch blade facing downward (as in the illustration) and where the switch is installed in the vertical, it is usually a wise precaution to use a type of disconnecting switch equipped with a locking device where the possible energy transmitted through the switch is 200 kw. or 100 amps. or more. Disconnects sometimes open under the powerful influence of electromagnetic forces accompanying heavy current rushes, as the short-circuiting of a generator, etc. The locked type of switch cannot do this.

With the arrangement of disconnects shown by Mr. Hibbs—that is, the horizontal with the switch blade facing downward, or closing upward—the switch blade is kept closed only by the friction between the blade and the clips and hinge of the switch. Poor contact between these, and a heavy blade, may result in the latter falling open after considerable time in service. Heavy currents, beyond the rating of the switch, may cause partial annealing of the clips, in which case the friction between the clips and the blade will decrease, possibly allowing the blade to fall open. This fact is also an argument in favor of the locked type of switch.

Chicago, Ill. W. H. DEMUTH.

## Better Cylinder-Oil Testing Methods

Wilbert Walton Cranford on page 327 of the March 4 issue of *Power* says, "The proper place to test a cylinder oil is in the cylinder of the engine," from which expression I would infer that Mr. Cranford would feel inclined to try any old oil on his best engine, although 1000 employees were dependent upon that engine for power. Certainly that would be imprudent and unbusinesslike as well.

As for utilizing a recording thermometer with two pens, as suggested, I should think such a plan would be a logical solution from a theoretical point of view. However, operating engineers know from years of experience that the valves invariably show distress first when the lubrication is faulty.

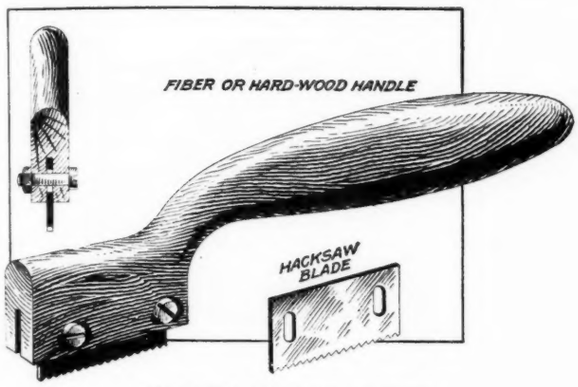
Should the absence of lubrication be so pronounced as to actually cause a rise in temperature of the cylinder walls, the result would be disastrous indeed, as the piston rings would likely seize, causing the whole cylinder to shiver or vibrate. The piston rings would tell the engineer about it a long time before the thermometer would. Furthermore, I believe it would be almost impossible to produce a higher temperature at the center of the stroke than at the heads, because the cylinder condensation would absorb the frictional heat as fast as generated. The fact of the matter is, if any difference in temperature were observed, the highest would be found at the heads, as the full boiler pressure exists at that point, and a much lower pressure would obtain at the center of the stroke, since it is customary to operate steam engines with cutoff at one-quarter to one-third stroke, allowing the steam to expand. The effect of compression must also be reckoned with, as it is customary to set the exhaust valves so as to produce a pressure equal to the normal steam pressure; very often it is higher.

Where superheated steam is used, the temperature is always higher at the heads, as evidenced by the pitting action upon the cast iron at these points of entrance. Mr. Crawford also speaks about cutting the oil down until the rise in temperature was perceptible. This would be analogous to cutting the lubricating oil down on the bearings until they showed signs of heating. Certainly, no practical engineer would be so foolish as to pull off such a stunt as that. WALDO WEAVER.

Franklin, Ohio.

## Commutator-Mica Cutting Tool

A handy tool for use in cutting down the mica between commutator segments of a motor or generator can be made by inserting a piece of hacksaw blade in a hardwood or fiber handle shaped as shown in the




COMMUTATOR MICA CUTTER

illustration. It can be made any size to fit the requirements. Two oblong holes are made through which bolts are passed in order to secure the hacksaw blade at any angle desired. W. W. PARKER.

Guantanamo, Cuba.

## Salvaging the Disabled

The editorial on page 371 of Mar. 11 isue under the caption, "Salvaging the Disabled," will appeal to the true American, I am sure, but I feel that the statement that "a partially disabled man can be trained to render efficient service as a switchboard operator, a pump runner or attendant of other auxiliaries" is a trifle misleading.

Years ago I was taught to hold one hand behind my back while working about the switchboard, and one day when I got a trifle careless and took a little dose of 600 volts, the chief remarked that the fools were not all dead but that one more came near being added to the list.

Today we expect our switchboard operators to use both hands and once in a while their feet. Less than half an hour ago I saw a switchboard operator barely save the load by mighty quick head and hand work when one machine kicked out.

I am not trying to get away from the fact that these men have fought and bled for a heroic cause, but one little false move of a partially disabled man in a power house might stall the wheels and deprive hundreds or thousands of work. Is it good business to ask a manufacturer to take on as a pump runner a man who is so crippled that he cannot properly look after the apparatus and when one false step would put the water for boilers or condensers out of the running? Is it not better that the profits of the business pay this man's living rather than take a chance?

It is true that "in the boiler room, with its stokers and modern appliances, special training and intelligence has replaced the requirements of brawn as of former days" to a degree, but I have seen more genuine "beef" used around a stoker plant than I ever saw used in a hand-fired plant. I am conversant with boiler plants from 5000 to 40,000 hp., and I can place only one in which the stoker superintendent holds a position that requires no manual labor of any kind.

My plant generates several thousand boiler horsepower, but the fireman on the shift is required to operate the stokers, maintain the proper draft to handle the load and supervise the coal handling inside the boiler-room walls, and at times he actually cleans fires. This work requires him to go from basement to bunker, a distance of forty feet or more, in quick step at times. Would you have a partially crippled man do this work? The man went to war, gave all that was asked and now that he is home must he work in a power plant, thinking that the work does not require a man with all of man's power?

Why lead people to believe that the power plant can use men who are partially disabled, when we who work there every day know that it requires all the energy of able-bodied men to produce the best results and even then we fall short at times? Why not let these men take positions of minor importance, and if the remuneration is not sufficient let those of us who were fortunate enough to be left at home be taxed to help support those that did go, but let us not, under the guise of helping these poor fellow men, place the heart of the factory, mill or shop in jeopardy. C. W. PETERS.

New York City.

## Removing a Broken Through Stay

I had an unusual experience recently. One head-to-head stay broke off at the thread at the back end in one of our 16-ft. x 66-in. return-tubular boilers. The job was to get the inside nut off and the stay out as there was not room enough to take the other nut off and cut the stay off in front of the distance piece.

I had a long chisel made to go down between the tubes so as to split the nut. H. R. JOHNSTON.

Vegreville, Alta., Canada.

## Easily Made Ferrule

Sometimes a ferrule may be lost from a tool handle or one is needed to put on a home-made handle which

THIMBLE USED AS A FERRULE

is likely to split if no ferrule is used. A ferrule can easily be made from an old thimble by cutting or drilling a hole in the end to fit the tool on which it is to be used, and applying it to the handle as shown.

Norristown, Penn. WILLIAM H. WATSON.

# Leaks and Wastes in State Institutions*

By F. J. McCULLOUGH

EACH pound of coal burned or each gallon of water allowed to reach the sewer without having accomplished a useful purpose might be called a leak or a waste. From the practical operating standpoint, however, it is necessary to draw a sharp distinction between a leak or waste that costs more to stop than to let it continue, and a leak that costs less to stop than to let it continue. The chief engineer must know what leaks and wastes exist, what they represent in dollars and cents and what it will cost to stop them. The leaks and wastes in an institution are a better indication of an engineer's ability than a civil-service examination.

Leaks and wastes may be classified under the following heads: Wastes of coal, heat, steam, electric current and water, and loss from damage to equipment. Waste of coal and heat in the boiler room was covered in previous papers. To give some idea of the loss of heat from uncovered pipes the following example may serve: Take a high-pressure uncovered pipe 6 in. diameter and 100 ft. long, carrying steam at 125 lb. pressure and located in a room where there are no drafts and the temperature is 70 degrees. Under these conditions each square foot of surface will give off 3.2 B.t.u. for each degree difference of temperature between the steam and the surrounding air. Steam at 125 lb. gage pressure has a temperature of 353 deg., and with air at 70 deg. the difference is 283 deg., so that each square foot of surface will give off 283 × 3.2 = 905 B.t.u. per hour. The 6-in. pipe 100 ft. long has 173 sq.ft. of surface, so that the loss each hour is 157,000 B.t.u. Assuming a boiler efficiency of 60 per cent. and coal at $3.50 per ton in the bin, with a heat value of 11,000 B.t.u. per pound, every cent's worth of coal burned puts 37,000 B.t.u. into the steam header. An hourly loss from the pipe of 157,000 B.t.u. means a waste in coal of 4¼c. per hour, $1.02 per day, or $372 per year. With the pipe covered, all this heat could not be saved, but standard-thickness 85 per cent. magnesia covering has shown an efficiency as high as 87 per cent., so that with steam continuously in the pipe the covering would effect a yearly saving approximating $324. At current prices the covering would cost about $1.15 per foot applied, so that in the saving of coal alone it would pay for itself in four months. The same pipe carrying 2-lb. steam pressure would waste enough heat to pay for 85 per cent. magnesia covering in less than a year.

### Fan or Hot-Blast Systems in State Buildings

A number of the state buildings are heated by fan or hot-blast systems. The average condensation in the coils per square foot of surface per hour is 1.56 lb. when heating air from 30 to 105 deg., but in zero weather, heating air from 0 to 105 deg. will condense 2.26 lb. per hour, or an increase of 45 per cent. It is evident that when the building is being warmed up in the morning and has few or no occupants, all the outside air should be shut off, and the air in the building recirculated by proper damper arrangement. Modern ventilating systems are designed for delivering from 25 to 30 cu.ft. of air per minute for each occupant. This will maintain a standard of purity of the air which has arbitrarily been decided upon, but this amount of air can be reduced almost one-half before any perceptible effect is noticed on the occupants. Then, as the ventilating apparatus takes 45 per cent. more steam when the outside air is down to zero, there is no reason why the standard for purity of air cannot be reduced during this time by recirculating from one-third to one-half of the air, and taking the remainder from the outside.

From a study of temperature records of the various state institutions it is evident that one serious loss is due to overheated buildings. These records show many instances of temperatures of from 75 to 80 deg. Temperatures may be considerably lower if attention is given to the humidity, the moisture in the air. In summer the relative humidity in this climate is usually 60 to 70 per cent., and as the windows and doors are open it is the same indoors as outside. With this humidity a temperature of 65 to 68 deg. is comfortable. In winter the outside humidity is about the same, but as the air is heated its capacity for moisture increases, so that the relative humidity is much less. In a steam-heated room it is seldom over 25 per cent. and is frequently less.

The accompanying illustration is a reproduction of a chart prepared by the Chicago Commission on Ventilation, who made a test of the Chicago Normal School a few years ago. From the chart it can be seen readily that as the humidity increases the temperature for greatest comfort decreases, and vice versa. These experiments showed conclusively that with a relative humidity of 55 per cent. and a room temperature of 66 deg. the occupants were just as comfortable as with a humidity of 25 per cent. and a room temperature of 74 deg., as may be determined by extending the chart slightly at the left.

In the latitude of Chicago the average outside temperature during the heating season is 34 deg. To keep a room at 66 deg. it is necessary to maintain a difference between inside and outside temperatures of 32 deg. With a room temperature of 74 deg. the difference is 40 deg. The heat losses from a building by radiation or air changes is in direct proportion to the difference between inside and outside temperatures, so to maintain a temperature of 66 deg. inside means a relative heat loss of 32 and to maintain 74 deg. means a relative heat loss of 40, or an increase of 25 per cent. in the amount of heat required to maintain the higher room temperature. The saving of heat by carrying higher humidity and lower temperature will be somewhat less than the 25 per cent., because some steam will have to be introduced into the room to raise the humidity and only a small part of the total heat of this steam will be given up to raising the room temperature. The amount of steam admitted into the room to maintain the humidity will be small, as compared to that required to maintain the room temperature, however. A saving of, say, 15 per cent. of all the steam used for heating would be worth trying for.

### Various Causes of Steam Waste

Steam is often wasted through steam traps. Most of the traps in state institutions, other than radiator traps, are of the intermittent or continuous discharge types, which can be equipped with gage glasses, a glance at which in passing tells the story. If the glass is full of water, the condensate is not being removed fast enough; if it is empty, the trap in all probability is leaking steam. On this type of trap the water should remain near the center of the glass.

General kitchens frequently are equipped with steam roasters. If they are steam-jacketed and the discharge is trapped, they are not as wasteful as the type that is not jacketed. To the latter type steam is admitted through a ¼-in. pipe with numerous orifices to give an even distribution of the steam. The vent to the atmosphere is made about an inch in diameter, so no pressure can build up in the compartment. There is also a drip connection for the condensate, but in reality most of the steam delivered to this type of cooker blows right through and goes out the vent.

Some time ago the writer put a steam-flow meter on a battery of six of these cookers, some of which were four tiers high and the others three tiers, so that there were 22 compartments of the same size. With steam at 40-lb. pressure each compartment took 66 lb. of steam per hour. As the pressure was reduced, the consumption of steam decreased until at 5-lb. gage pressure each compartment only took 28 lb. per hour. This represented a saving of considerably over 50 per cent. and did not interfere with the operation of the cookers or the time required to cook the food. Even though the temperature of the steam at

*Abstract of paper read at the first annual meeting of chief engineers of Illinois State Institutions, Dunning, February, 1919.

40-lb. pressure is 74 deg. higher than steam at atmospheric pressure, as soon as it expands in the cooker to atmospheric pressure it has a temperature of only 212 deg., the 1 or 2 per cent. of moisture that the steam carries preventing it from superheating at the point where it is throttled.

When there is an excess of exhaust, as in the summer months, the waste of steam from leaky engine valves, scored cylinders or worn cylinder rings and from the valves not being properly set is a direct loss. Steam is wasted also through leaky back-pressure valves, valve stems, defective gaskets at flanges and at the threads where they are not tight.

### Waste of Electric Current

In the winter time, when there is not enough exhaust for heating, the only real loss due to waste of current is the additional wear and tear on the machinery producing the current and the renewal of lamps, but during the summer months electric wastes are dead losses and should be prevented as far as possible. Motors should not be allowed to run when the machines they drive are not in use, and on alternating-current generators the voltage should be controlled as much as possible by the exciter rheostat instead of the generator rheostat. The exciter rheostat carries a small current, just enough to excite the fields of the exciter, but the generator rheostat carries all the current the exciter delivers, which is about twenty times that of the exciter rheostat. Hence it should be set with only a few points of resistance cut in, to be used in getting the fine adjustment of the generator voltage, and as much of the controlling as possible should be done with the exciter rheostat.

Incandescent lamps are built for a life of approximately 1000 hours of burning. If they last much longer than that, it means the voltage on the line is too low and that the lamps are uneconomical because they are not up to candlepower and the wattage consumed is too great for the light they are giving. On the other hand, if their life falls short of 1000 hours, it means the voltage is too high and the lamps are uneconomical because of the cost of frequent renewals.

Where the condensing water from ammonia condensers is run to sewer, thermometers should be installed to give the temperature of the water at the inlet and the outlet from the condenser, so that the water may be throttled down to a point at which the rise in temperature over the condenser will not exceed ten degrees. Even where the water is used again, it costs money to repump it. If the condenser is above the vacuum pumps of the heating system, all the makeup required for the boiler plant should be taken from this source to save repumping. In fact, one of the best places to admit the make-up water, during the heating season, is just ahead of the vacuum pump.

There is a leakage of water from faucets and bad underground pipe. Self-closing faucets, when kept in order, make a material saving in water. Cast-iron pipe should be used for all underground work where possible, as it lasts longer than steel pipe.

Recently, one institution that had a high per capita water rate made a study of where the water was going by installing temporary meters on the different lines and taking readings throughout the twenty-four hours. The total water consumption was reduced a little over one-third, but the gain is gradually being lost, and today only one-sixth less water is being used than before the saving campaign. This shows how difficult it is to stop wastes and keep them stopped, even after it is known where they occur.

With hot water it should be pointed out that it is not only a waste of water but also a waste of heat in the water. Assume water to cost ten cents per thousand gallons, and that it is heated 80 deg., from 60 to 140 degrees. For one cent, 100 gal., or 834 lb., of water is purchased, and it requires one B.t.u. to heat one pound of water one degree. Hence into one cent's worth of water there go $834 \times 80 = 66{,}720$ B.t.u. Previously, it was shown that one cent's worth of coal put 37,000 B.t.u. into the steam, so that each cent's worth of water requires two cents' worth of coal to heat it. The wasting of one gallon of hot water is equivalent to wasting three gallons of cold water.

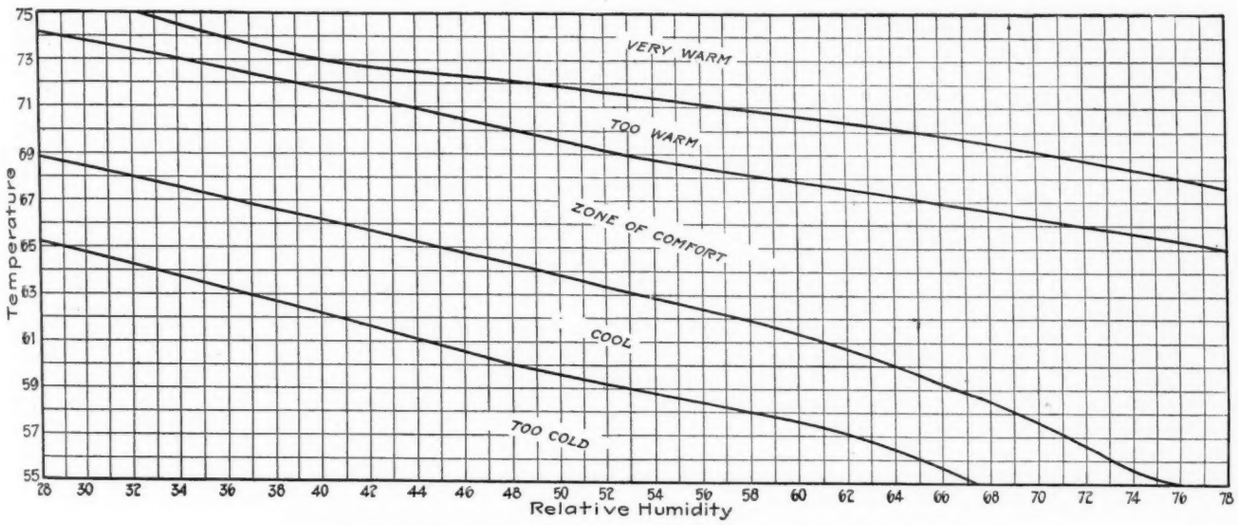



CHART SHOWING HUMIDITY INCREASE AND COMFORT DECREASE

Hot water, of course, is wasted at faucets, just as the cold water, but with an additional waste where it is necessery to flow gallons in order to get warm water. In all hot-water lines circulation through the heater should be maintained with a pump so there will be no dead-ended lines in which the water can cool. There are leaky valve stems and threads, where the loss of heat or water may be insignificant, but which result in a loss from damage to the covering, pipes and floor. In the power house hot-water waste should be watched carefully, as here are the more important items of waste from traps and drips, which may be going to the sewer when they should be returned to the feed-water heater. Then there are leaky blowoff valves and the overflow from the feed-water heaters or the hot-water receiving tank. In order that the engineer may more readily see these losses, it is well to have only one direct connection to sewer from the power house, this being required for the boiler blowoffs. All other connections to sewer should be made, where possible, through open tell-tales.

One piece of equipment often abused is the steam pump. Boiler-feed pumps are generally set where accessible to the firemen, which generally means in the boiler room, where they are subjected to coal and ash dust. This results in damage to plungers and rods and with scored rods trouble in holding the packing. Where possible it is well

to have the pumps in a small room or inclosure with plenty of glass in it, so that the operations of the pumps may be observed from the boiler room. Steam pumps are not built for high piston speeds, and in this respect the vacuum pumps are frequently abused. As the vacuum is impaired by leaky return lines or radiator traps, it is the tendency to speed up the pumps instead of looking for the real trouble.

Oftentimes the engineer thinks that the more vacuum he carries the better the heating system will work. Three or four inches of vacuum should be enough on any building, while often it is carried so high as to have a vacuum on the steam main even back to the oil separator in the power house. With this condition existing, cylinder oil will be carried over into the heating system, resulting in a great deal of radiator-trap trouble, which will extend back to the boilers.

## A. I. E. E. Annual Convention

The American Institute of Electrical Engineers will hold its annual convention this year at Lake Placid Club, Adirondacks, N. Y., June 24-27. The principal features of the program, as announced in the May proceedings of the Institute, are: Tuesday morning, June 24, address by President Comfort A. Adams, and the presentation of two papers, "Present Day Practice of Transmission and Tie Line Relay Protection," by H. R. Woodrow, D. W. Roper, O. C. Traver and P. MacGahan and "Grounded Neutral," by H. R. Woodrow and William E. Richards. Tuesday evening, informal reception and dance. Wednesday noon, conference of Committee on Development, section delegates and A. I. E. E. officers at luncheon. Thursday morning, conference under the auspices of Committee on Development, including section delegates and Institute officers, open to all Institute members. Friday morning four papers will be presented: "High-Tension Single-Conductor Cables for Polyphase Systems," by W. F. Clark and G. B. Shanklin; "Electrostatic Field and Electric-Power Cables," by H. W. Fischer and R. W. Atkinson; "Commercial Problems of 220,000-Volt Power Transmission," by A. E. Silver; and "The Effects of Transient Voltage on Dielectrics—II," by F. W. Peek, Jr.

The committees have purposely left considerable time unassigned, as it is expected that the conferences under the auspices of the Committee on Development will be one of the most important features of this convention and will undoubtedly occupy considerably more time than the sessions that have been scheduled. It is also the aim of the committees to leave plenty of time for social and recreation features, including outdoor sports, to which the location at Lake Placid is especially adapted.

## Engineering Courses Popular

One of the most popular divisions of education made available to disabled soldiers by the Federal Board for Vocational Education is that of engineering, in the various branches of which there are now 178 students, thus giving refutation to a somewhat prevalent idea that the vocational education available for disabled men is confined to manual trades. In this general classification, 6 men are taking architectural engineering; 2 chemical engineering; and 80 are preparing to be civil engineers. Electrical engineering takes 30; general engineering, 25; mechanical, 22; mining, 7; and steam, 8.

Indicating the character of institutions at which these men are pursuing their education, the following are being used: Harvard University, Massachusetts School of Technology, Franklin Union, Boston, Hawley School of Engineering, New Bedford Industrial School, Saunders Trade School, New York Electrical School, Mechanics Institute, Pratt Institute of Brooklyn, Rensselaer Polytechnic School, Columbia University, Heffly Institute, Lawrenceville Trade School, Carnegie Institute, Pennsylvania State College, Johns Hopkins University, Georgia School of Technology and Colorado State School of Mines.

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Claude Graham-White, the English aviator, says regarding the proposed transatlantic flight: "Everything depends on the engine. If a machine breaks down, the wireless goes also, and then, no matter what the safety devices may be, the machine makes a very little speck on the enormous area of the Atlantic. If the feat is successful the public will applaud it, but if lives are lost there will be censure on account of the foolhardiness of the attempt."

## Personals

**R. L. Thomsen** has been appointed sales manager by the Terry Steam Turbine Co., Hartford, Conn. Previous to this appointment Mr. Thomsen was manager of the marine department for the Griscom-Russell Co.

**W. W. Tarleton,** who has been connected with the Southern Manganese Corp., of Anniston, Ala., for the last two years in the capacity of purchasing agent and traffic manager, has joined the sales department of the Anniston Steel Co., same city.

**Miles Carey,** of Welch, W. Va., who has been division manager of the Appalachian Power Co. for six years, has resigned that position to accept another with the Penn Public Service Co., of Pennsylvania, and will be located at Clearfield, Penn. B. P. Rouse, who has been connected with the company for some time past, succeeds Mr. Carey as manager.

**R. W. Spofford** has been appointed local general manager of the Manila Electric Railroad and Light Co., Manila, Philippine Islands, by the J. G. White Management Corp., New York, the operating managers of that company. Mr. Spofford, after graduating from the United States Naval Academy at Annapolis, spent about five years in the Navy. After his retirement in 1911 he was engaged by the J. G. White Management Corp. and was assigned to the staff of the Augusta-Aiken Railway and Electric Corp., Augusta, Ga., and later was made general manager of that company. When the United States entered the war, Mr. Spofford, as a naval reserve-officer, was called to the colors. With the signing of the armistice he was placed on the retired list of the Navy, with the grade of lieutenant commander.

## Engineering Affairs

**The American Society for Testing Materials** will hold its twenty-second annual meeting in Atlantic City, N. J., June 24-27, with headquarters at the Hotel Traymore.

**The National Association of Stationary Engineers,** New York, State Association, will hold its twenty-fourth annual convention at the Rensselaer Hotel, Troy, N. Y., June 12-14.

**Yonkers Association No. 28, N. A. S. E., of New York,** held its annual entertainment and ball at the Elks' Club on April 29. The event was largely attended and a general good time was had.

**The New England States Association** of the National Association of Stationary Engineers will hold its annual convention and mechanical exhibition at Springfield, Mass., July 9-12.

**The American Order of Steam Engineers,** in conjunction with the American Supply Men's Association, will hold its 33rd annual convention in Atlantic City, June 9-13, with headquarters at Morris Guards Armory, and official headquarters at the Continental Hotel.

**Brooklyn Association No. 8, N. A. S. E.,** held an open meeting on Saturday, May 3, at its rooms, 125 South Elliot Place, Brooklyn, N. Y. Several novelty "stunts" in education were successfully presented and proved highly interesting to the big audience. This introduction of the educational and social features combined is the idea of John H. McGowan, president of the association.

**The American Institute of Electrical Engineers** will hold its annual business meeting on May 16, in the auditorium of the Engineering Societies Building, New York City, at 8:30 p. m. At this meeting the board of directors will make its annual report, including a complete financial statement for the year ending Apr. 30, 1919. The report of the tellers will also be presented, giving the results of the election of officers for the ensuing administrative year. The Weaver Memorial Tablet, which is to be erected in the headquarters of the Institute "in acknowledgment of the services rendered to the Institute and to the electrical engineering profession by William D. Weaver," will be exhibited at this meeting. Immediately following the business meeting the ceremony of the presentation of the Edison medal will take place. This medal was founded by the Edison Medal Association, composed of associates and friends of Thomas A. Edison, and is awarded annually by the Institute "for meritorious achievement in electrical science, electrical engineering, or the electric arts." The medal has been awarded this year to Benjamin G. Lamme "for invention and development of electrical machinery."

## Miscellaneous News

**New Power Rates,** effective May 18, have been filed at the city clerk's office at Lockport, N. Y., by the International Power and Transmission Co. Increases vary from 10 to 25 per cent. New rates are: First 250 hp., $25 per hp. per year; next 500 hp., $22 per hp. per year; excess of 750 hp., $19 per hp. per year.

**A Sawmill Belonging to Tom Crouse,** near Victor, Fayette County, W. Va., blew up a few days ago. Mr. Crouse and his son were close to the engine mending a part, when the boiler went up over their heads, demolishing the mill. Beyond a few bruises from falling sticks, Mr. Crouse and his son were unhurt. Debris from the explosion was picked up a quarter of a mile away.

## Business Items

**Dean Bros.**, of Indianapolis, Ind., announce the opening of a New York City sales office at 141 Broadway, with H. Meachem as district sales manager.

**Edward J. Smith**, hydraulic engineers, of New York, announce that they have established an office in El Paso, Texas, in the Mills Building, Rooms 812 and 813.

**Briggs & Turivas**, of Chicago, Ill., have opened an office in New York City, at 1805 Equitable Trust Building, under the direction of Carl R. Briggs, president of the company.

**The Hill Pump Valve Co.**, of Chicago, Ill., announces that it is maintaining a New York office in conjunction with the Homestead Valve Manufacturing Co., at 1 Franklin St., New York City, with P. L. Rhodes in charge as manager.

**The F. W. Freeborn Engineering Co.**, of Tulsa, Okla., announces that Vincent G. Shinkle has become a partner in the organization. The company is now devoting its activities exclusively to the various phases of the oil industry.

**Pioneer Rubber Mills** is the name under which the Bowers Rubber Works of San Francisco is now operating. The change in name became effective Apr. 1, but the management and policy of the company continue as under the old name. The Pioneer Rubber Mills will continue to manufacture all the brands that the Bowers Rubber Works established.

**The Homestead Valve Manufacturing Co.**, of Homestead, Penn., has added Charles Nagle to its New York office. Mr. Nagle will call upon the trade within New York City and Brooklyn. It has also placed an additional man, F. H. Thorn, in its Pittsburgh office, who has had several years of experience in the mechanical engineering field. Mr. Thorn will devote his time exclusively to the plants within the Pittsburgh district.

**The American Tube and Pipe Bending Co.**, with offices in the Schofield Building, Cleveland, Ohio, has been formed for the purpose of furnishing bent boiler tubes for any make of vertical water-tube boiler. The active head of the company is A. Wasser, secretary and treasurer. Mr. Wasser was connected with the Erie City Iron Works for thirteen years both in the factory and sales office, and is thoroughly familiar with practical boiler construction.

**Meyer, Strong & Jones, Inc.**, have succeeded to the engineering practice of Henry C. Meyer, Jr., and Bassett Jones, Associated. Mr. Strong was connected for many years with the American Radiator Co., as chief engineer, and is now its consulting engineer. Messrs. Meyer and Jones have been engaged in consulting work in New York City since 1903 and have been responsible for the mechanical, electrical and power equipments of many important buildings and large industrial plants. C. A. King, H. E. Meeker, H. F. Richardson and J. J. Ruckes, who have been associated with Messrs. Meyer and Jones for a number of years, will be in responsible charge of the work in the new organization. The new firm will act as consulting engineers for steam and electrical work, power plants, etc., and will have offices at 101 Park Ave., New York City.

## Trade Catalogs

**The Vulcan Soot Cleaner Co.**, Du Bois, Penn., has issued a new bulletin entitled "Vulcan Soot Cleaners for Return Tubular Boilers." This bulletin describes the company's Model "M," front-end type, and Model "R," rear-end type. It also shows how the cleaner is installed in settings of typical construction, and gives results of various tests that have been conducted. A copy may be had free upon request.

**The American Steam Conveyor Corp.**, Chicago, has issued a helpful booklet on the ash-handling question, entitled "Reducing Ash Disposal Costs." The diagram and description of an American steam ash conveyor that saved over $3 a day in ash handling and in the course of eighteen months paid for itself, should be of interest to engineers and power-plant executives. The experience of a number of other users of the steam jet ash conveyor in securing ash-disposal economies are described. Diagrams and photographs of actual installations are also given. A copy of the booklet will be sent free upon request.

## THE COAL MARKET

BOSTON—Current prices per gross ton f.o.b. New York loading ports:

**Anthracite**

| | Company Coal |
|---|---|
| Egg | $7.80@7.95 |
| Stove | 7.95@8.15 |
| Chestnut | 8.05@8.35 |

**Bituminous**

| | Clearfields | Cambrias and Somersets |
|---|---|---|
| F.o.b. mines, net tons | $2.15@2.75 | $2.80@3.35 |
| Philadelphia, gross tons | 4.20@4.90 | 5.00@5.40 |
| New York, gross tons | 4.50@5.25 | 5.35@5.80 |
| Alongside Boston (water coal), gross tons | 6.10@6.85 | 6.90@7.65 |

Pocahontas and New River are quoted at $4.70 @5.25 f.o.b. Norfolk and Newport News, Va., for spot coal, and $7.20@8.60 alongside Boston, these prices being on a gross ton basis.

NEW YORK—Current quotations, White Ash, per gross tons, f.o.b. Tidewater, at the lower ports* are as follows:

| | Mine | Company Circular | | Mine | Company Circular |
|---|---|---|---|---|---|
| Broken | $6.05 | $7.90 | Pea | 4.90 | 6.65 |
| Egg | 5.95 | 7.80 | Buckwheat | 3.40 | 5.15 |
| Stove | 6.20 | 8.05 | Rice | 2.75 | 4.50 |
| Chestnut | 6.30 | 8.15 | Barley | 2.25 | 4.00 |

**Bituminous**

| | Spot | Contract |
|---|---|---|
| South Forks | $2.90 @ $3.25 | $2.95 @ $3.50 |
| Cambria County (good grades) | 2.75 @ 2.95 | 2.95 @ 3.25 |
| Clearfield County | 2.50 @ 2.75 | 2.80 @ 2.95 |
| Reynoldsville | 2.50 @ 2.75 | 2.75 @ 2.95 |
| Quemahoning | 2.65 @ 2.85 | 2.95 @ 3.10 |
| Somerset County (best grades) | 2.65 @ 2.85 | 2.95 @ 3.10 |
| Somerset County (poorer grades) | 2.00 @ 2.35 | 2.50 @ 2.75 |
| Western Maryland | 2.25 @ 2.75 | 2.50 @ 2.75 |
| Fairmont | 2.00 @ 2.25 | 2.35 @ 2.50 |
| Latrobe | 2.10 @ 2.25 | 2.25 @ 2.40 |
| Greensburg | 2.25 @ 2.35 | 2.35 @ 2.60 |
| Westmoreland | 2.60 @ 2.75 | 2.60 @ 2.75 |
| Westmoreland run-of-mine | 2.40 @ 2.65 | 2.35 @ 2.65 |

Quotations at the upper ports for both bituminous and anthracite are 5c. higher on account of the difference in freight rates, and are exclusive of the 3% war freight tax.

PHILADELPHIA—The price per gross ton f.o.b. cars at mines for line shipment and f.o.b. Port Richmond for tide are as follows:

| | Line | Tide | | Line | Tide |
|---|---|---|---|---|---|
| Broken | $5.95 | $7.80 | Buckwheat | $3.40 | $4.45 |
| Egg | 5.95 | 7.80 | Rice | 2.75 | 3.65 |
| Stove | 6.20 | 8.05 | Boiler | 2.50 | 3.50 |
| Nut | 6.30 | 8.15 | Barley | 2.25 | 3.15 |
| Pea | 4.90 | 6.50 | Culm | 1.25 | 2.15 |

CHICAGO—Current prices per ton for Illinois and Indiana coal are as follows:

**Illinois**

| Williamson, Saline and Williamson Counties | Southern Illinois F.o.b. Mines | Northern Illinois F.o.b. Mines |
|---|---|---|
| Prepared sizes | $2.55@$2.75 | $3.25 |
| Mine-run | 2.35@2.50 | 3.00 |
| Screenings | 1.85@2.20 | 2.75 |

BIRMINGHAM—Current prices per net ton f.o.b. mines are as follows:

| | Mine-Run | Prepared | Slack and Screenings |
|---|---|---|---|
| Big seam | $2.45 | $2.75 | $2.40 |
| Black Creek and Cahaba | 3.45 | 3.75 | 3.05 |
| Jagger - Pratt Corona | 2.85 | 3.05 | 2.45 |
| Blacksmith | | 5.25 | |

Domestic quoations, slightly increased, are as follows:

| | Lump and Nut |
|---|---|
| Black Creek and Cahaba | 3.85@$4.50 |
| Corona | 3.40 |
| Jagger | 3.50 |
| Montvallo | 5.00 |

ST. LOUIS—The prevailing circular per net ton f.o.b. mines is as follows:

| | Mt. Olive and Staunton | Standard |
|---|---|---|
| Franklin County | | |
| Prepared sizes, lump, egg, Nos. 1 and 2 nut | $2.75 | |
| Williamson County | | |
| Prepared sizes, lump, egg, nut | $2.55 | $2.55 | $1.90@2.25 |
| Mine-run | 2.35 | 2.20 | 2.00 |
| Screenings | 2.20 | 2.05 | 1.75 |
| 3-in. lump | | 2.30 | |
| 2-in. lump | | | 2.15 |

Williamson-Franklin rate to St. Louis is $1.07½; other rates 92½c.

## New Construction

### PROPOSED WORK

**Mass., Pittsfield**—The Berkshire County Commissioners will install a steam heating plant in the 2 story, 50 x 80 ft. Hall of Records which they plan to build here. Total estimated cost, $100,000. J. M. Vance, Main St., Arch.

**R. I., Johnston**—The Board of Education will install a steam heating plant in the 5 story, 80 x 150 ft. school which it plans to build in the Thornton Dist. Total estimated cost, $120,000. Hoppin & Field, 32 Westminster St., Providence, Arch.

**Conn., Hartford**—The city will install a steam heating plant, refrigerating and cold storage machinery in the 1 story, 63 x 122 ft. public market which it plans to build on the corner of Boulevard and Ferry St. Total estimated cost, $100,000. Whiton & McMahon, 36 Pearl St., Arch.

**Conn., New London**—The S. D. Lawrence Estate, c/o B. A. Copp, 48 Bank St., Trustees, will install a steam heating plant in the 3 story, 56 x 110 ft. business building which it plans to build on Bank St. Total estimated cost, $100,000. Hilderbeck & Langdon, Inc., 253 State St., Arch.

**Conn., West Hartford**—Sleeper & Parisi, c/o Marchetti & Davino, Arch., 756 Main St., Hartford, will install a vapor heating system in the 4 story, 78 x 136 ft. apartment hotel which they plan to build on Farmington Ave. Total estimated cost, $130,000.

**N. Y., Astoria**—Glynne & Ward, c/o the Alhambra Theatre, Knickerbocker Ave. and Halsey St., Brooklyn, will install a steam heating system in the 2 story theatre which they plan to build on Grand and Steinway Ave. Total estimated cost, $400,000. T. Lamb, 644 8th Ave., New York City, Engr.

**N. Y., Bronx**—B. S. Moss, 729 7th Ave., Manhattan, will install a steam heating plant in the 2 story, 125 x 150 ft. theatre which he plans to build on Prospect Ave. and 161st St. Total estimated cost, $600,000. De Rosa & Pereira, 110 West 40th St., Manhattan, Engr.

**N. Y., Buffalo**—The Prudential Life Building is in the market for a generator and machinery for a power plant. J. Lovel, Ch. Engr.

**N. Y., New York**—The League for Political Education, 15 West 44th St., will install a steam heating plant in the 5 story, 100 x 125 ft. institute which it plans to build on 43rd St., near B'way. Total estimated cost, $150,000. McKimm, Mead & White, 101 Park Ave., Arch.

**N. Y., New York**—The N. Y. Telephone Co., 15 Dey St., will install a steam heating plant in the 4 story, 103 x 115 ft. exchange which it plans to build on 107th St. and Grand View Place. Total estimated cost, $391,000. McKenzie, Voorhees & Gmelin, 1123 B'way., Engr.

**N. Y., New York**—The Park Realty Co., 151 West 42nd St., will install a steam heating plant in the 14 story, 25 x 100 ft. hotel which it plans to build on 5th Ave. and 78th St. Total estimated cost, $250,000. G. E. Blum, 505 5th Ave., Engr.

**N. Y., Ossining**—The State Hospital Commission, Capitol, Albany, will soon receive bids for the construction of a 1 story, 30 x 30 ft. pump house, in connection with the 4 story, 50 x 200 ft. clinic building which it plans to build at the Sing Sing Prison here.

**N. Y., Pelham**—The Board of Education will install a steam heating plant in the 2 story, 168 x 171 ft. high school which it plans to build. Total estimated cost, $115,000. Tooker & Marsh, 101 Park Ave., New York City, Engr.

**N. Y., Rochester**—The city is having plans prepared for the construction of a sewage disposal plant in the 23rd Ward, to include 1 Imhoff tank and pumping system to care for the territory between Lata Rd. and Beach Ave. Address J. F. Skinner, Asst. City Engr.

**N. Y., Syracuse**—The H. H. Franklin Manufacturing Co., 302 South Geddes St., will install a low pressure vacuum heating system and motors in the 2 story, 70 x 150 ft. addition which it plans to build to its present plant. Total estimated cost, $85,000. R. J. Reidpath & Son, Builders Exchange Bldg., Buffalo, Arch.

**N. Y., Syracuse**—The New York State Railways plans to expend $200,000 for transmission and trolley line changes, track repairs and street paving here.

**Del., Wilmington**—The Wilmington Free Institute will install a steam heating plant in the 3 story, 90 x 200 ft. library which it plans to build. Total estimated cost, $400,000. Boring & Tilton, 52 Vanderbilt Ave., New York City, Arch.

**Md., Baltimore**—The Harvey Co., 113 South St., is in the market for two, 8-wheel, 10 ton locomotive cranes, with 40-50 ft. boom; 2½ Climax crusher with elevator; a 25 hp. engine on wheels; 11 or 13 in. swing 3 ft. bed second-hand engine lathe, back geared and screw cutting; 2 road rollers, 3 wheels, Buffalo-Pittsburg preferred.

**D. C., Washington**—The Liberty Savings Bank, 1410 New York Ave. N. W., will install a steam heating plant in the 1 story, 25 x 139 ft. bank which it plans to build on 15th and Eye St. Total estimated cost, $ 00,000. Holmes & Winslow, 110 West 40th St., New York City, Engr.

**Fla., Key West**—Norberg-Thompson is receiving bids for the construction of a cold storage and distilling plant. Estimated cost, $60,000.

**Fla., Mulberry**—The International Fertilizer Co., Jacksonville, plans to build a steam plant near here.

**La., New Orleans**—The Bureau of Yards & Docks, Navy Department, Washington, D. C., plans to install mechanical and electrical equipment at the power house here. Specification No. 3882.

**Ohio, Cleveland**—The Champion Welding Co., 604 Prospect Ave., is in the market for a 50-60 hp. gasoline motor and a 15-20 k.w.c.d. motor or generator.

**Ohio, Cleveland**—The Paul Bros. Co., Citizens Bldg., will install a steam heating plant in the 6 story, 99 x 132 ft. factory and garage which they plan to build on East 18th St. and Euclid Ave. Total estimated cost, $175,000. W. S. Ferguson Co., 1900 Euclid Bldg., Engr.

**Ohio, Cleveland**—The Shaw-Hayden Amusement Co. will install a steam heating plant in the 3 story theatre and commercial building which it plans to build on Shaw and Hayden Ave. Total estimated cost, $100,000. W. Norris, Pres. W. S. Ferguson Co., 1900 Euclid Bldg., Engr.

**Ohio, Dover**—The Tuscora Rubber Co., c/o the W. C. Owen Engineering Co., Engrs., 1900 Euclid Bldg., Cleveland, will install a steam heating plant in the 3 story rubber factory which it plans to build here.

**Ohio, Jewett**—The city is having plans prepared by W. J. Sherman, Engr., 613 Nasby Bldg., for the construction of a water supply system, to include the sinking of wells and the construction of a pumping plant.

**Ind., Washington**—The city plans to remodel and enlarge the electric light and power plant. Widmer Engineering Co., Century Bldg., St. Louis, Mo., Consult. Engr.

**Mich., Detroit**—The C. B. Bohn Foundry Co., Hart Ave., plans to build a 2 story, 80 x 100 ft. power plant to contain steam plant equipment, consisting of boilers, engine and accessories. Estimated cost, $25,000. C. W. Brandt, Kresge Bldg., Arch.

**Ill., Brooklyn**—The Terminal R. R. Association, Union Station, St. Louis, Mo., plans to rebuild its 50 x 150 ft. boiler shop, here, recently destroyed by fire, entailing a loss of $35,000. W. Bawden, Room 411, Supt.

**Wis., Sheboygan**—The Standard Oil Co., 1209 Pennsylvania Ave., is in the market for 4 boilers, to be installed in the 2 story, 40 x 95 ft. filling station which it plans to build on Wisconsin and 7th St. Leiser & Holst, 105 Wells St., Milwaukee, Arch.

**Wis., Two Rivers**—The Wisconsin Textile Manufacturing Co. will install a 60 hp. steam plant for heating and 20 motors, 2½ to 20 hp. capacity, in the 1 story, 90 x 200 ft. factory which it plans to build on Main St. Total estimated cost, $100,000. Address G. Kirst.

**Minn., St. Cloud**—The Granite City Investment Co. will install a steam heating and mechanical ventilating system in the 5 story, 120 x 120 ft. commercial hotel which it plans to build on Main St. Total estimated cost, $300,000. Holstead & Sullivan, Palladio Bldg., Duluth, Arch.

**Mo., Jefferson City**—The State Legislature passed bill authorizing the building of a water trunk line to supply large area in northern Missouri. Work involves pumping equipment, iron pipe, and steel tanks. etc. Address A. L. McCawley, c/o Pub. Serv. Comn.

**Mo., St. Louis**—The Manufactures Railway, 2925 South B'way., is having plans prepared for changing the switching system from steam to electric. Work involves installing poles, trolleys, transformers and a 24 mi. transmission line. Estimated cost, $200,000.

**Mo., St. Louis**—The University Investment Co., La Salle Bldg., will install a steam heating plant in the 5 story, 110 x 130 ft. apartment hotel which it plans to build at 4471 Olive St. Total estimated cost, $160,000. Kennerly & Stiegemeyer, Benoist Bldg., Arch.

**Ark., Searcy**—The Arkansas Hydro-Electric Co., Heber Springs, has had plans prepared by Dickinson & Watkins, Engr., Boyle Bldg., Little Rock, for building a 40 ft. dam and spillway near here. Plans include the construction of a power house and transmission lines. Estimated cost, $262,500.

**Okla., Henryetta**—The city voted $310,000 bonds for waterworks improvements, to include the installation of additional pumping equipment, filtration plant, settling basins, supply line and distribution system. H. M. La Rue, Supt. of Waterworks. Burns & McDonnell, Interstate Bldg., Kansas City, Mo., Consult. Engr.

**Okla., Yale**—The city plans election soon to vote on $100,000 bonds for electric light extensions.

**Cal., Calexico**—The city is having plans prepared by Olmsted & Gillelen, Engrs., 1112 Hollingsworth Bldg., Los Angeles, for the construction of a gas and electric plant here. Estimated cost, $325,000. P. B. Steintorff, City Clk. Noted Jan. 7.

**Cal., Fresno**—The Fresno City Water Co. plans to drill wells and build 2 pumping stations, 1 near Wilson Ave. and the Atchison, Topeka & Sante Fe Ry., and the other near C and California St.

**P. E. I., North Wiltshire**—The Department of Public Works, Ottawa, Ont., will receive bids until May 13 for the construction of a 2 story, 47 x 61 ft. power house and laundry at the Dalton Sanitorium here. Plans include the installation of heating apparatus. Estimated cost, $70,000. R. C. Wright, c/o Dept. of Pub. Wks., Arch.

**Que., Montreal**—The Place Viger Terminal Co. will soon award the contract for the construction of a 10 story, 83 x 180 ft. cold storage plant on Berri St. Complete refrigerating machinery will be installed in same. Total estimated cost, $600,000. A. Chausse, 72 North Dame St., East, Arch.

**Que., St. Raphael East**—The Montmagny Electric Co., Montmagny, plans 2000 hp. development on the River du Lud here. Estimated cost, $300,000. Gauvin & Co., 147 Mountain Hill, Quebec, Arch.

**Ont., Hamilton**—The Hamilton Hockey Club plans to build an artificial ice plant in connection with the 1 story, hockey and skating arena which it plans to build. Estimated cost, $200,000.

## CONTRACTS AWARDED

**Conn., Waterbury**—The International Silver Co., 93 Silver St., has awarded the contract for the construction of a 1 story, 45 x 80 ft. addition to its power house, to L. A. Miller, 22 Church St., Meriden. Estimated cost, $25,000.

**N. Y., New York**—The Commonwealth Ice Co., 7 East 42nd St., has awarded the contract for the construction of a 2 and 3 story, 101 x 169 ft. ice plant, on 67th St. and West End Ave., to the J. H. Taylor Construction Co., 110 West 40th St. Estimated cost, $70,000.

**N. Y., Niagara Falls**—The U. S. Light & Heat Corp., 3215 Highland Ave., has awarded the contract for the construction of an industrial plant on Highland Ave., to the J. W. Cowper Co., Fidelity Bldg., Buffalo.

**N. C., High Point**—The city has awarded the contract for installing pumps and motors at the proposed water plant, to the Morris Machine Works, East Genesee St., Baldwinsville, N. Y., for $4,320.

**Ill., Chicago**—The Hydrox Co., 3542 Normal Ave., has awarded the contract for the construction of a 3 story ice and ice cream factory on Lake Park Ave. and 24th St., to the Midland Engineering & Construction Co., 332 South Michigan Ave. Estimated cost, $225,000.

**Ore., Salem**—The Valley Packing Co. has awarded the contract for the construction of a 3 story, 82 x 82 ft. meat packing plant at North Salem, to F. J. Leonard, Lewis Bldg., Portland. Plans include the construction of 24 x 36 ft. building for boiler room, rendering tanks and fertilizer department. Total estimated cost, $130,000.

**Ont., Sydenham**—The Department of Public Works, Ottawa, has awarded the contract for the construction of a power house, heating system, etc., at the Sydenham Military Hospital here, to W. H. Harvey, Kingston. Estimated cost, $65,000. Noted March 18.


# Opportunities!

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